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APRIL MEETING

OF THE

Massachusetts Association of Boards of Health.

The April meeting of the Massachusetts Association of Boards of Health was held at the Parker House, Boston, on Thursday, April 24, Dr. Samuel H. Durgin, Vice-President, in the chair.

On motion of Dr. Hibbert W. Hill the records of the January meeting were taken as read.

Mr. Coffey, Secretary, submitted the following names of applicants whom the Executive Committee recommended for membership in the Association: —

T. J. COLLINS	Springfield
FREDSON N. GREY	Leominster
R. A. ELLIOTT, M.D.	Avon
E. P. LINFIELD	Avon
WILLIAM H. KELLIHER, M.D.	Woburn
DENNIS G. DOHERTY	Woburn
JOHN TIMLIN, M.D.	Melrose
JAMES H. MCGRATH	Clinton
F. T. HYDE, M.D.	Weston
A. W. DRAPER, V.M.D.	Milton

On motion of Professor Sedgwick the ten gentlemen named were elected members, the Secretary casting one ballot for them.

The CHAIRMAN.— We have with us to-day the kind of gentleman that we frequently look for on these occasions. I have the pleasure of introducing Mr. Edward R. Warren, of Boston, who will read a paper on "Smoke Nuisance."

THE RESULT OF IMPERFECT COMBUSTION OF FUEL.

BY MR. EDWARD R. WARREN.

The most apparent and serious result of imperfect combustion of fuel is the commonly known smoke nuisance, an evil far-reaching in its consequences and one which many of the large cities of the world are striving to conquer. It is especially appropriate that this matter should be brought to your attention as members of the boards of health of the cities and towns of Massachusetts, from the fact that the citizens of this Metropolitan District have come to realize the necessity of taking active steps through your co-operation toward abolishing this serious nuisance which is every day growing worse. Until within recent years Boston has always been a bright, cheerful, smokeless city; but, with the introduction of bituminous coal as a cheap and economical fuel, these conditions have unfortunately materially changed.

The smoke nuisance may be found in its most aggravated form in Pittsburg, Cleveland, and other of our Western cities, as well as in the great manufacturing towns in England. It owes its existence chiefly to unintelligent, careless, and wasteful use of bituminous coal and other fuels, which, if properly burned, are both efficient and economical.

Until recently it has been considered a necessary evil, and little attempt was made to find a remedy; but, with the enormous growth of manufacturing in cities and the consequent increase in consumption of coal, the smoke conditions have become so intolerable that at last strenuous efforts are being made to abolish the nuisance.

Ingenuity first expressed itself in repeated endeavors to find

devices for consuming smoke, but these attempts met with comparatively little success; and means of smoke prevention were sought, which have proved from every point of view to be the wise and proper solution of the problem. The old saying that "an ounce of prevention is worth a pound of cure" certainly applies in the case of a smoke nuisance. This reform deserves the active moral support of all who have the welfare of the community at heart, and only through unselfish co-operation can it be successfully accomplished. An adequate law for the suppression of smoke is of course necessary, with proper provisions for penalty in the case of repeated violation. But experience shows us clearly in the examples which we have in other cities of the world that, after all, the best results may be attained by an exercise of moral suasion and gradual educational training; and it therefore seems appropriate and wise that the direction of this work should be under the control and guidance of boards of health under whose charge all similar nuisances are placed.

Whether or not an atmosphere heavily laden with smoke and soot is directly injurious to health, in the form of disease, it must at least have an indirect effect, as a result of uncleanliness, dampness, and want of sunshine and cheerfulness. It may reasonably be claimed that mental and consequently physical condition is impaired under such depressing influences.

A distinguished London physician, who has made a careful study of the question from a standpoint of health, claims that the smoke produced from the burning of certain bituminous coals is highly charged with sulphur, which, coming in contact with a moist atmosphere, produces sulphuretted acid, which is one of the most insidious irritants of the human system.

Fortunately, aside from the moral and æsthetic reasons why the prevalence of smoke is a detriment to the common interests, a very important consideration is the economic advantage of smoke prevention; and those who cannot be appealed to from public spirit may be influenced by a convincing demonstration that it is to the pecuniary interest of the consumer of coal to prevent smoke. For smoke implies imperfect combustion, with a consequent loss in heat units from the escape of unconsumed gases and carbon. It is estimated

that frequently the loss of fuel from careless firing is from 15 to 25 per cent. It is also fortunate that it has been proved by experience that bituminous coal and other smoke-producing fuels may be burned properly and economically without the employment of expensive mechanical devices for smoke prevention if reasonable care is taken in the construction of the furnaces and grates and if faithful and skilful firemen are employed.

In this connection it may be well to say a few words concerning the smoke problem as we find it successfully solved in the city of Berlin, where for sanitary, æsthetic, and economic reasons the most careful attention and study has been given to the prevention of smoke. The city has a population of nearly two millions and a half, and is equally important as a beautiful residential city and as a manufacturing centre. One-third of its business interests are manufacturing, although the coal-mining districts are remote, which necessitates the transportation of fuel from a distance. In 1900 there were 1,351 manufacturing establishments in Berlin; and during this same year the total consumption of coal was nearly 3,000,000 tons, all of which, with the exception of 80,000 tons of anthracite, was a low grade of bituminous coal.

The clear atmosphere of Berlin is chiefly due to excellent management on the part of the city authorities and to efficient police control. Expensive mechanical devices, such as automatic stokers, down-draft furnaces, and patent grates, are used in Germany to some extent; but they are not considered essential, as it has been found that practically as good results may be attained by faithful and intelligent hand-firing. It is not enough that a man should be able to shovel coal to make him a good fireman; but, unfortunately, this seems to be too often the standard of excellence in the United States. It seems strange that with all the economies which are necessarily practised in manufacturing to-day, as a result of competition, that economy of fuel has been so carelessly overlooked and so recklessly neglected. If the consumer of coal is saving from two to three dollars a ton by using bituminous coal in place of anthracite, he seems content with this economy, which requires no ingenuity and little thought, and burns the bituminous coal so wastefully and unintelligently that not only does he cause great annoyance and

discomfort to his neighbors, but a direct loss to himself of from 15 to 25 per cent. in fuel. A proof of this enormous loss may be used by the advocates of the abatement of the smoke nuisance as a sufficient argument, leaving out of consideration the higher motives.

In the United States our coal supplies are so enormous and so varied that we scarcely realize the important part which economy plays in other parts of the world where fuels are less abundant, and consequently more expensive. The inferior qualities of soft coal which are used in Berlin cost from five dollars and a half to seven dollars a ton delivered at wholesale. They are all of a much lower grade than the ordinary Nova Scotia coal; and, unless they are carefully burned, they produce much smoke. Two-thirds of the anthracite coal used in Berlin is imported from England, and costs at retail from ten dollars to twelve dollars a ton. It is therefore easy to see the relation which economy bears to the smoke problem in Berlin. The dependence upon hand-firing in Germany has led to the establishing of schools for the training of firemen, and this is one of the best smoke lessons which Germany has to teach us. These schools for a nominal fee of from two to three dollars afford two weeks' instruction in the art of firing and the care of boilers. In Prussia there are seven of these schools, and there are many others in other parts of Germany. The men so trained are greatly in demand, and it is a very interesting and significant fact that these training schools have been the direct means of raising the standard and wages of firemen in Germany. Why should not some such wise provision for teaching the art of firing be undertaken in this country? There are many of the smaller boiler plants in manufactories and apartment houses in which, with reasonably well-constructed furnaces, soft coal might be used without causing objectionable smoke if ordinary intelligence were employed in the care of the fires. Such firemen would deserve good wages, which the employer could well afford to pay, since, as a consequence of this intelligence and care-taking, the saving in coal would be a substantial item.

It is worth repeating that with a great amount of smoke there is a correspondingly great loss in heat units. Smoke is caused by the generation of gas and hydro-carbon, which are liberated from the coal at a temperature below that which is required for combustion.

This unconsumed material passes through the chimney largely in the form of soot. The principle of good firing is a very simple one. If the surface of a fire is thickly covered with fresh coal, the temperature of the furnace is suddenly lowered, combustion is arrested, and gases are formed which the heat is not sufficient to ignite; and, consequently, the draft causes them to pass over the fire-bridge into a lower temperature, which converts them into smoke and soot. This may be easily prevented by taking care, before firing, to push forward the incandescent mass toward the bridge and to add a moderate amount of coal, placing it within and near the furnace door, where it may gradually heat and coke. When it is in a condition for combustion, it should be pushed forward and spread over the surface of the fire.

The most common and wasteful practise of careless firing is in applying too much coal at a time, and, what is still worse, in throwing in the coal upon the hottest part of the grate. The true secret of good firing is to furnish uniform air supply, and to add small amounts of fresh coal at frequent intervals.

In the English cities the difficulties to be overcome are much greater than ours. This is principally due to the fact that the domestic use of bituminous coal is largely responsible for the smoke. It is much more difficult, and, in fact, impossible, without the greatest care, to prevent smoke arising from the open fires and kitchen stoves. In such cities as Birmingham, Manchester, and Liverpool the conditions have become so hopelessly bad, with the combination of smoke from boiler plants and domestic fires, that any attempt at improvement meets with great discouragement. Some progress, however, has been made, especially in Manchester. In London, where the conditions are much better, there has been considerable activity, especially during the past few years. It is claimed that the presence of smoke in the atmosphere is to a great extent the cause of the London fogs. Sir William Thiselton-Dyer has been conducting experiments during some of the recent fogs, and has found that in a week six tons of solid matter, consisting of soot and tarry hydrocarbons, were deposited on one square quarter of a mile; and he asserts that this matter is injurious both to animal and vegetable life.

The experts who are at work in London are hopeful that with the

further suppression of smoke from factories and more care in the homes the densest fogs may be prevented.

Sir C. A. Cookson, in a lecture before the Royal Institute of Public Health, stated that, so far from the evil being desperate, the remedy lies in the hands of London housewives. The Coal Smoke Abatement Society of London, which since 1898 has been under the guidance of Sir William Richmond, R.A., reports great improvement in fogs during the month of November, 1900, which, it is claimed, was due to a reduction of smoke as a result of the persuasive influence of smoke inspectors. At a meeting of the society was exhibited a marvellous atmospheric deposit which was taken from the cornice below the dome of St. Paul's Cathedral. It is estimated that it had probably taken two hundred years to form. An analysis showed that in one hundred grains there was one grain of carbon and one-half a grain of a tarry substance, chiefly gypsum or crystallized sulphate of lime, produced by the action of the sulphuric acid of the city atmosphere on the carbonate of lime of the building stone. This sulphate of lime is first dissolved by and then deposited from the rain-water, and during its formation it is mixed with the soot. Sir William Richmond has estimated that 6,000 tons of coal are daily carried away in the atmosphere from the chimneys of London.

Turning our attention to what is being accomplished in cities in this country, and to the wide-spread interest which is being taken in this important reform, we find the city of Cleveland in the lead; and the progress which has been made is remarkable. After compulsory smoke abatement had been repeatedly tried in Cleveland, without success, it was found necessary to form an Anti-smoke Nuisance Society, which adopted the policy of gradually educating the consumers of coal, showing them the economic advantages of good stoking and perfect combustion. Good anti-smoke laws were passed; and, with constant effort, the conditions in Cleveland have been much improved. With the co-operation of the municipal association, an important amendment to the statute law was effected in 1900, which created a separate department of the city government, having for its sole function the care of this reform. Professor C. H. Benjamin, the most prominent expert in the United States on this

subject, was appointed supervising engineer; and the whole matter has come under his charge. Not only has the work been successful in effecting improvement in stationary plants, but it has also accomplished most encouraging results in suppressing the smoke from the locomotives of the railroads, which in such a railroad centre as Cleveland is a most important factor. In spite of great opposition Professor Benjamin has gained the confidence of the people, and has convinced them that the enforcement of reasonable anti-smoke legislation rather than opposing the manufacturing and commercial interests is a benefit to them; and the Chamber of Commerce has given its approval to the movement.

St. Louis is also taking active steps; and it was recently reported at a meeting of the Citizens' Smoke Abatement Association that 310 steam-jet and air-blast furnaces had been installed, 113 down-draft furnaces, 35 brick arches, and 7 automatic stokers, a total of 466 smoke-abating devices.

For many years Chicago has been trying in vain to solve the smoke problem, at first with a view of finding some form of smoke consumer, which is now generally acknowledged an unsuccessful method. They have since been working in the direction of smoke prevention with more hopeful results; and it is reported that automatic stokers and other devices have been installed in no less than 354 buildings, and that scarcely any smoke is emitted from their chimneys. These cases which have been cited are cities in which the smoke nuisance has gained tremendous headway, which makes any change for the better very difficult.

In the Eastern cities, in which the use of bituminous coal is but a recent innovation, the question is a defensive one; and with reasonable precaution it is quite possible to prevent the evil from spreading, and it is further possible to cure it. As a proof of this, we have a shining examp'e in New York City, where the control of the smoke nuisance has for many years been in the hands of the Board of Health. Although the law is exacting, and provides that the discharge of smoke, cinders, soot, and dust, is declared a nuisance and shall not be permitted, the enforcement of this law is so justly and reasonably administered that it has not proved a hardship to the community. Having with us to-day an inspector of the New York

Board of Health, he will tell us in detail how the law is enforced. Suffice it to say that the Board of Health has gained the confidence of the community, that its best smoke inspectors are the people themselves, which is a co-operation of forces which is most desirable and effective.

With the law so enforced by an autocratic and discretionary board, the danger is eliminated of political influence, which may naturally arise from the employment of smoke inspectors under the control of a city government. It is also proper that this nuisance, as all others are, should be in the care of boards of health. The atmosphere in the city of New York is clearer and freer from smoke than it is in any other large city in the world where such enormous amounts of bituminous coal are consumed. A smoking chimney is an exception, and yet more soft coal is burned annually in New York than in Boston.

It is unfortunately true that up to the present time we have treated this important matter with indifference. From time to time laws have been passed, which have never been accepted by our town and city governments. Inspectors, it is true, have been appointed; but, either from want of ability or proper direction, they have never been able to suppress the smoke to any desirable extent.

It is proper to call to your attention, as members of the boards of health of the State of Massachusetts, that our committee has given this subject careful study at home and abroad, comparing our conditions in Boston and its vicinity with those which exist in cities where the subject has been carelessly neglected, as well as with those where systematic effort and public spirit have been the means of abolishing the smoke nuisance to the benefit of all concerned. These investigations have led us to believe that immediate action is necessary; and, profiting by a good example, the bill which is now before the legislature has been carefully drafted on the same lines as the New York City law, which places the control of the smoke nuisance in the hands of the Board of Health. A very important feature of the bill is that it provides for a Metropolitan District, an area which includes the city of Boston and all cities and towns in whole or in part within a radius of ten miles of the State House. The act is legislative rather than local or municipal. The necessity

of this provision is obvious. In consequence of the free circulation of smoke from one locality to another the law should take effect simultaneously, and it would seem unwise to provide that it should be optional upon the part of each city and town government to accept or reject it.

It is hoped that this bill will be enacted during the present session of the legislature, that its enforcement by the boards of health may result in the abatement of the smoke nuisance within a reasonable time, and that, as a result, it may lead to the adoption of like measures by the governments of other cities and towns in the Commonwealth.

The CHAIRMAN.— The discussion will be opened by Professor Sedgwick.

Professor SEDGWICK.— Mr. Chairman and gentlemen,— after Mr. Warren's very clear and excellent paper, it is unnecessary for me to go into much detail on this subject. Boston and the vicinity have a smoke nuisance. Some people say they have not; but, if you will watch from the top of any building in this city for a little while at any time of day, you will see a number of chimneys pouring out dense black smoke, and at certain times, when the atmosphere is quiet, you can see this same phenomenon with the greatest ease. You will find, moreover, that it is not confined to Boston, but that the chimneys in Cambridge and in Somerville, and I dare say in other suburban towns of the Greater Boston, are doing the same thing.

Now how has this come to pass? It has simply been due to the introduction of soft coal. Some have said, "Well, then, why not stop the use of soft coal?" It is not believed that that would be judicious or wise. Soft coal is splendid manufacturing fuel. It is cheap. It has high heating-capacity. It burns freely. And it has undoubtedly, in my judgment, come to stay. We are bound, then, I think, to have soft coal; and the question is simply, Shall we allow Boston to become a Chicago, a Cleveland, a Cincinnati, or a Pittsburg, or shall we keep it, as it always has been, a region of clear skies, pure air, beautiful buildings, and pleasant to live in? Some will say, "Well, we never shall burn enough soft coal to do any great harm"; and they will point out with justice that the trouble in London

is largely due to the fact that the householders, in their kitchen fires, burn soft coal. That is true in London; but it is not true here, and is not likely to be at present. The people have become fond of and used to hard coal in houses, they have stoves that burn hard coal, and it would be a hardship if they were obliged to turn over to burn soft coal. I do not think that that danger is imminent.

The question is, then, Shall the chimneys which are used for power plants, apartment houses, hotels, and the like, be allowed to burn soft coal in any way they please? A number of us believe that they ought not to be, and that now is the time to stop it; and we believe, furthermore, that there is no hardship in compelling them to burn soft coal intelligently. What does that mean? It means for small plants that they shall use intelligent firemen. They may have to pay twenty-five or fifty cents a day more to the firemen in some cases, in order to get a man of intelligence and a man who is not merely a thrower-on of coal. How does it work to-day? Simply like this: The fireman comes round in the morning; and the fire is low, perhaps. He throws on a lot of coal at once upon the hottest part of the fire, reduces the temperature of the whole fire. It smoulders, and the chimney belches forth black smoke, which is not merely smoke, but has a lot of soot mixed with it. Then he gets up his fire, and takes his morning paper, perhaps, and sits down to read; and, getting interested in the daily story, or the latest crime or sensation or political event, whatever it may be, he forgets his fire for a little while, and goes on reading. Suddenly he wakes up to the fact that the steam has gone down, the fire is going down; and he thereupon throws in another big dose, and then comes out a lot more of smoke. That is what we mean by unintelligent firing. It is perfectly demonstrable that with perfect firing you can burn soft coal without smoke, providing you have sufficient grate-bar capacity, sufficient draft and throat of chimney, and sufficient height of the chamber above the fire.

Now, to show the state of things in Boston, I want simply to pass around some pictures which were taken last year by one of my assistants, Mr. Underwood, whom you know very well, the man who has talked to you on mosquitoes, and who has talked to you on the Cambridge marshes, a member of the Board of Health of Belmont, and

one of the brightest men we have in the Association. I got Mr. Underwood, last year, to study up this problem and take some photographs. We will begin, if you please, with his own manufacturing establishment down on Fulton Street; that is, the William Underwood Company, where they pack the devilled ham that you have often bought when you go on picnics. It has a red devil on the top of the little can. It is one of the important manufacturing industries of this State, but not, of course, one of the biggest. They burn two or three tons of soft coal a day there, and they have an intelligent fireman. They have sufficient grate-bar capacity and throat of chimney and draft and so on; and what is the result? The result is that there is no smoke. Here [exhibiting a photograph] is the chimney, this one in the middle of the picture, and no smoke is coming out. Mr. Underwood went and photographed that unknown to the fireman. Then he went to the fireman, and asked him to stir up the fire, and put on coal, and make all the smoke that he could by ordinary stoking, while he went out and took a photograph; and, when the man did that, and stirred things up a good deal, he got that amount of smoke [exhibiting another photograph]. That was all he could get out of it, doing his worst, because he had sufficient grate-bar capacity and draft and mechanical arrangements,— purely mechanical: I don't mean mechanical stokers or anything of that kind, but had things built as they should be. That lasted less than three minutes, and at the end of two minutes that was all the smoke there was coming out [exhibiting another photograph]. That was doing his worst in a hand-fired place, with an ordinary arrangement, not specially adapted to prevent smoke. And that shows that smoke need not come out of small plants, provided they are rightly built, and provided there are right people in charge.

But there are plants in this city which are not intelligently fired, and here are some of them. There is the stack of Houghton & Dutton, which you have seen smoking as you have come up and down Beacon Street very often, and smoking very badly. Here it is again, belching out black smoke, as it is, in fact, doing most of the time. There is no secret about this. Anybody can go and see it, of course; and many of you have seen it over and over again.

Then, in the immediate neighborhood of this hotel, just over here

by City Hall avenue, is the Niles Building, and that [exhibiting a photograph] is what the Niles Building was doing a good deal of the time last winter, and has been doing some of the time since, but less after these photographs were shown in the legislature last winter. Here it was on another day. This was not very far from the smoke inspector's office, and I felt, and I think I had a right to feel, that the smoke inspector was not a very live man when that sort of thing was going on. There you have it. It is an interesting demonstration of how not to do it.

But there are other people that need looking after. There is Uncle Sam. The Post-office Building has two chimneys. One of them at this particular moment was pouring out a great deal of black smoke, the other a little; and they take turns. Sometimes they work together.

In order to see what the city as a whole showed, Mr. Underwood went up on top of the Hotel Essex; and he got the next view. Now that is very instructive. It shows that most of the city is free from smoke, but that there are certain places that are smoking very badly. There was Houghton & Dutton; and here is the Niles Building, if I am not mistaken. Here is the Post-office; and there was another building further down town, of which I don't know the name. In other words, there were localized emissions of smoke coming out. But there are other cases which are bad. Here is the power-house of the Boston Elevated Railroad, which you have all seen smoking almost constantly night and day, pouring out vast volumes of black smoke. It is on Albany Street. Here it is again, on a day when the smoke does not go off over the harbor, but drops down on the neighborhood. If you can look at that, and say that Boston has no need to wake up on this subject, you have a different opinion from mine.

And then, in order that you may say, "Well, after all, these are only a few localized things," I want to show you what Mr. Underwood got from the top of the Hotel Touraine, looking north-eastward. Here is the big square stack of the Edison Electric Light, which, you know, often pours out vast quantities of smoke. But what is more important is the general appearance of that picture. Can you look at that, and say that Boston is not on the road to a condi-

tion such as you get in Cincinnati and Chicago and Cleveland? I tell you it has gone a long way in that direction; and it is high time that we waked up, and did something about this matter,— high time. Just study that picture as it goes round, and say, if you can, that there is no need of action.

I have shown how easy it is to deal with the thing when it is done in a small way, provided you get intelligent firing; but many of these establishments are not hand-fired, or at least they use so much coal that it becomes desirable to do something else. We have several establishments in the city which are models of good firing; but there is one in particular, namely, the South Terminal Station, which has a power-house on the east side of the station, toward the salt water, not very far outside the station. You probably have noticed a brick building there, where they make the Pintsch gas, and where they furnish the power for lighting the Terminal Station and for heating it and for heating the cars in winter, and so on. They burn there from twenty-five to fifty tons of soft coal a day; and, if you go down and look for their chimney, you won't find it. There isn't any chimney, to begin with. All the chimney you can find after looking around is that big thing in the middle of this picture, which is only thirty feet high; and, as you look at it and watch for the smoke to come out, it does not come. There isn't any. That is the way that thing works, to the best of my knowledge and belief, most of the day. Mr. Underwood, after taking a photograph of it, went and asked them to stir up things and make all the smoke they could, while he went out and took a picture. They did so, and that is what he gets. Mr. Underwood is one of us, gentlemen. He is a member of the Belmont Board of Health. He is a scientific man. He has no interest in this thing except the interest of the public health. These pictures are perfectly straight and honest; and that is all he got.

How do they do it? That is a wonderful result. How do they get it? It is no more wonderful than what they have in many cities where they have abated the smoke nuisance altogether; but it is wonderful for a city which is so far on the road to the smoke nuisance. They do it in this particular case by the use of a mechanical stoker. It is an arrangement which works by steam. It is attached

to the feed, to the coal supply, in such a way that every little while it pushes in some coal, which falls down steps where the coal is afire. But the hottest part of the fire is way over beyond, and the coal that is first put in before it gets there has coked a little bit. Then it is pushed on, and pushed on; and, as it gets hotter and hotter, it is finally thoroughly burned. The smoke from the first part passes over the back part of the fire, is raised to a high temperature, and is burned there. That is one of the well-known "mechanical stokers."

There are other kinds. There is a very ingenious one which is being used in Cleveland and in many other places a good deal, the agent of which sent me a circular the other day, saying that they would guarantee a fuel economy of 10 per cent. Now a fuel economy of 10 per cent. will pay for a mechanical stoker very quickly. This is known as "an under feed." I mention it to this extent, because there are several "under-feed" stokers. This one has the very ingenious thought underneath it of pushing the coal up into the middle of the fire from below, so that the hottest part of the fire and where the most of the combustion is going on is always on top; and whatever smoke is generated down in the bottom of the fire has to go up through the hotter parts of the fire. It is a very ingenious scheme.

There are many ingenious schemes. The American people have the power of invention. They are not going to allow their cities to become smoky holes, like London. It is idle to say that we, who are invading the markets of the world with our commercial enterprise, have not got brains enough and energy enough to overcome the smoke nuisance. We have, and we are going to do it.

Now, gentlemen, speaking purely personally and for myself, I want you to do what you can to help on the passage of this bill in the legislature. We have a general law for the cities and towns of the State, but it is only applicable when accepted by the city councils. Many of them won't accept it; and, even if they did, it is only a local thing. The Greater Boston, with Brookline and Cambridge and Newton and Milton and Somerville and Chelsea, and all the rest, is one great city. If smoke is made in East Cambridge, it will roll over upon Boston, as I saw it doing within a week, so that the

Common, Boston Common, had a lot of smoke on it directly traceable to East Cambridge. Conversely, Boston makes smoke, and pours it over on to Cambridge and Somerville and Brookline. This bill is for the good of the whole community. We believe that there is no hardship in requiring the consumers of soft coal gradually, and after a reasonable length of time, which this bill provides for,— for it is not to go into effect until January 1, and in exceptional cases may be delayed until July 1, 1903,— we say we believe that there is no hardship in requiring the consumers of soft coal either to put in mechanical stokers or devices which shall prevent the emission of smoke or else to have firemen intelligent enough and careful enough and willing enough to do their work to do what they call "one-shovel" firing, putting on one or two shovels at a time instead of half a ton at a time, and then sitting down and smoking a pipe. That is the whole root of the trouble. The thing is perfectly simple.

Having studied the matter thoroughly, I honestly believe that we shall not be inflicting any serious hardship or injustice upon any manufacturer or commercial interest. We want the commercial interests to prosper in this community, but we want also the æsthetic and the domestic and the sanitary interests to be conserved. It lies in your hands and mine, gentlemen, and in the hands of the intelligent citizens of the Greater Boston and their friends in the legislature from all over the State, to say whether this evil shall continue or whether it shall be throttled in its infancy. If we allow the city once to get full of smoky chimneys, the standard of the people will be let down. They will take a hopeless attitude. They will say: "Well, you cannot help this thing. It has come, and it has grown up around us; and it is too late now to do anything." Now, therefore, is the time. I would appeal to you to use all proper and legitimate efforts to impress upon your representatives in the legislature the reasonableness and the need of this reform to-day and in the present session of the legislature. The Committee on Cities has been interested. It has revised the bill in a skilful and good way; and we believe that the bill, when carefully studied, will meet the approval of an intelligent community. We are not ready to have the beautiful buildings of Boston become smutted and smirched and blackened by soot. We

don't like to have our muslin curtains befouled with soot and smoke; and we do like to keep clean with our books and papers, in engineering offices and in law offices and wherever we are. Above all, we want to keep Boston, and the Greater Boston, as a desirable *home* for the people; and we know that, if we begin by making them dirty with smoke and soot, it will be difficult to keep them clean from the sanitary point of view in other directions. This is to a great extent a sanitary question. We will grant that the death-rate of London, where the smoke is abundant, is low. We will grant that many cities which have a smoke nuisance have a lower death-rate than some cities that have no smoke nuisance. But we do know that smoke favors fog, and that general habits of dirt induce specific habits of dirt; and we believe that this is a proper field for boards of health.

Fortunately, we have with us to-day a gentleman who can tell us what they have done in New York. I can tell you from my own personal observation, repeated now many times, that the city of New York is practically smokeless, and that the city of Boston is on the down track in this direction, and moving very rapidly; and, if we don't look out, it will get so far down that it will not be easy to bring it back to its former clean condition. This thing is only five or six years old in any magnitude; and, if we work now, and all together, and for the best interests of the community, I believe that posterity will be grateful to us through all generations. [Applause.]

The CHAIRMAN.— I have now the pleasure of introducing a gentleman from New York who is assistant chief in the Department of Food Inspection and Offensive Trades, and has particular charge of this matter which has been the subject of the paper by Mr. Warren. I take great pleasure in introducing Mr. Russell Raynor, of New York. [Applause.]

Mr. RUSSELL RAYNOR, of New York.— Mr. Chairman and gentlemen, I think that perhaps the best way to show you what we do in New York would be for me to start in with a smoke case at its beginning, and follow it right straight through to the end, describing the way our inspectors look after it. Then I will give you a few

figures, showing you the number of cases that we have had in the past four years, and what has become of them.

In the first place, the citizens of New York are probably the best smoke inspectors that we have. If you let a little bit of a chimney start up and smoke under a man's windows, inside of a day you either have a telephone complaint or a written complaint. Besides the complaints which come in from the citizens, the sanitary inspectors of the department are assigned to small districts for general sanitary work; and, in addition to that, they are required to take cognizance of all discharges of smoke that they may see in their district or even that they may see outside of their district. They report the name and address, together with the character of the business. Then the records are looked up; and, if there is no order in existence against the plant, an order is issued. After the smoke has been seen, an order is issued by the department requiring the owner or the lessee or the tenant or whoever is in responsible charge of the premises to discontinue the discharge of smoke forthwith. Forthwith means that the plant is reinspected the day after the issuance of the order.

After the order is issued, a duplicate copy of the order is referred to the original inspector who recommended it. He then reinspects the premises; and, if he finds after watching the chimney for half or three-quarters of an hour that there is no smoke, then he is justified in returning that the order has been complied with. But we don't stop with one inspection. We take another inspector, and send him there the next day or within a few days at a different time during the day, so that, if the first man happened to catch the chimney during a light period, the other man might have a little better luck. He watches it for half or three-quarters of an hour; and, if he gets no smoke, why, then he indorses it "Order complied with." Then it goes to a third man, and he goes through the same routine. If, at the end of three inspections, we find that all three inspectors report that there is no smoke, we feel justified in presuming that the nuisance has been abated or, at any rate, it is so reduced that there is no further cause for complaint.

If, on the other hand, the inspector finds that smoke is still being discharged, he indorses on the report that smoke is discharged and

the nuisance is not abated. That paper is immediately referred to the corporation counsel. The corporation counsel has a printed form, which is mailed to the man in whose name the original order has been issued, notifying him that his attention has previously been called to a violation of the sanitary code, and that, if the order is not complied with within two days or before the next inspection by the inspector, or if he has not begun work to comply with the order before the next visit of the inspector, the matter will be presented to the criminal courts. Then, after the two days have expired, the order is sent back to the inspector. He makes another careful inspection. If he finds smoke, he then goes in and sees the engineer or the superintendent or the owner or the highest man in authority that he can reach, and has a little conversation with him, and gets him to admit that he is the responsible man. Then he takes a look down in the fire-room, and sees what sort of coal they are using, whether they have any smoke consumers or any smoke preventers or mechanical stokers or whether they are using any particular care,—in fact, gets a general idea of the situation. Then he reports back that he has found smoke, and he also makes a little report of these additional facts. The paper then goes to the corporation counsel again; and, unless there are some very great extenuating circumstances in the case, he then orders the arrest.

It has been customary in the past for all arrests to be made by two or three of the older inspectors, men that have been with the department the longest, and consequently have had more experience in doing court work. Up to within about six months ago I practically made all the arrests that were made. The way I would usually do was this: I would take a man with me armed with a good-sized camera (I have some pictures here which show a little different condition), and put him up on some convenient roof somewhere, let him take pictures of the chimney for five or ten minutes, showing the discharge of smoke. Meantime I would go down in the office, have a little talk with the proprietor. I sometimes would have a sanitary policeman with me. In other cases, where the violation was less flagrant, I would procure a warrant from the police magistrate.

After we had gotten everything together and I had made up my

mind that my photographer had some pictures that would prove to be useful as evidence, the sanitary policeman would then make his arrest and take the proprietor to the police court. He there usually would be held under bail for examination. Very frequently, after a man has been arrested, he gets much busier than he was before he was arrested; and in about half of the cases they abated the nuisance between the time they were arrested and the time the case came up for the hearing. The rest of them had to go to trial, but out of the total number of cases that we have had there were only some forty odd that ever got as far as a trial.

Since the middle of 1898 there have been 446 orders issued altogether on smoke nuisances. And, by the way, we do not call it a smoke nuisance in New York, we do not attempt to prove it a nuisance: we simply say that the discharge of smoke is a violation of the law, under Section 134 of the Sanitary Code. We had 446 cases altogether; and 190 of those were caused by the careless burning of sawdust, shavings, and wood refuse, and things of that sort, in manufacturing plants, furniture factories, and piano factories and places of that sort,— absolute carelessness usually accounts for these cases,— and the other 256 were from soft coal. Some of them were in rolling mills, others in power-houses, breweries, and the rest in general manufacturing plants. In those 446 cases it was only necessary to make arrests in 97 cases, and of those 97 cases 43 were discharged in the police court because they had abated the nuisance between the time that they were arrested and the time that they came up for examination. Of the 54 that went to trial, 19 abated the nuisance between the examination and the time of their trial; and in those cases, after we had succeeded in obtaining a conviction, the corporation counsel recommended that the court suspend the sentence. So that of the total number of cases brought there were only 35 in which there were fines imposed, and of those cases 24 were burning coal and 11 were burning sawdust. We collected fines amounting to $975 for coal and $575 for sawdust. Almost as much of our trouble has been caused by sawdust as coal.

When an order has been issued against a plant, it has been very customary for the owner, or the engineer, or some responsible man, to call at the office, and say: "Well, now, gentlemen, we will be very

glad to stop this smoke; but we don't know how to do it. We wish you to recommend a smoke consumer." We invariably have refused to recommend anything. We have said, "We are not here to stop nuisances ourselves: we are simply here to tell you that there is a nuisance, and you must stop it." A man has sometimes gone away and tried, and at other times he has teased a bit for the information. The greatest extent to which we have gone in giving advice has been to mention half a dozen other places in the city that are carrying on the same line of business that he is, and say: "Go and see So-and-so. He had a smoke nuisance, and he has stopped it. And this other man has stopped it, and So-and-so has stopped it." We have tried to pick out three or four different devices, so that we could not have the name of recommending anything in particular. Sometimes the owners have adopted some of the devices that they have seen, in other cases they have put on something entirely different, and still in other cases, as Professor Sedgwick has pointed out, they simply have abated the nuisance by careful firing.

To show that all these statements that have been made about New York City, or about the cleanliness of the atmosphere of New York City, are close to the truth, before I came on here two weeks ago to speak on this smoke matter to the City Committee of the legislature, I had a few photographs taken. Without telling the photographer what my object was, I said, "I want you to go around the city and take pictures from tall buildings and other points of vantage, that will show the condition of the city as it exists to-day." He started out on Friday and Saturday morning, April 3 and 4, and took these pictures from different parts of the city. I doubt very much if in any of them you can find anything that looks like smoke at all.

This first picture was taken from the top of the tower of the new East River bridge, which is going across the East River from New York to Williamsburg, somewhere near the foot of Grand Street. It is looking north-west, right over a crowded district of tenement houses and a large number of small factories, small wood-working factories and factories with one little boiler, where they are burning soft coal and refuse and everything else all mixed up. That was taken some time through the morning; and, as far as I can see, there is no sign of smoke in the picture at all. This group of three were taken from

the top of the *World* building, and one is looking over toward Brooklyn, one is looking down town, and one is looking out over City Hall and over toward the Hudson River and Jersey; and there is no smoke in them. The next two pictures are all in the neighborhood of the gas-works and some of the slaughter-houses on the west side of the city, where they burn bituminous coal almost exclusively for power purposes. This next picture is one of the power-houses of the New York Edison Company. It is not complete yet, but the two right-hand stacks have boilers under them which are in operation. They are burning nothing but soft coal in that plant, and have the furnaces fitted with Rooney stokers. This is a picture of the brewery district, 92d Street in the neighborhood of Second and Third Avenue. There are somewhere in the neighborhood of six or eight breweries in this group. Every one of them uses soft coal. At times they have made quite a little discharge of smoke, and I think the engineers of at least three of them have been arrested at different times. At present there is no smoke there. This next picture is a general picture of the east side of the city in the neighborhood of 23d Street to 42d Street. It takes in two power plants, those two large electric light power plants, and a number of small wood-working plants. That was taken from a ferry-boat, and is a little bit hazy, owing to the motion of the vessel. It is not very distinct. And this last picture is one that approaches nearer to your — I think you call it the West End power-house. . . .

Professor SEDGWICK.— Elevated Railroad.

Mr. RAYNOR.— It is the power-house that furnishes the power for the Metropolitan Traction Company. That was taken Saturday at half-past eight or nine o'clock in the morning, right at the busiest time in the day, when everybody was going down town to business. They have in there about 100 boilers. Each one of them is of about 850 horse-power. There never has been a pound of anything but soft coal in the place, so far as I know. The boilers are all fitted with Rooney stokers. While sometimes you will get a little more smoke than you ought to have from the chimney, this picture shows the chimney as it is under ordinary circumstances, perhaps

twenty-nine days out of thirty. These pictures are a very fair exhibition of what New York is to-day. You can go round Manhattan Island on a boat, or cross the North or East River on a ferry-boat, and take in the water front of the borough of Manhattan, the borough of Brooklyn, the borough of Queens, and part of the borough of Bronx, and I doubt very much if in the whole trip you would see over two or three chimneys, at the very outside, smoking; and it would be very safe to say that those three chimneys were under observation, or had an order pending against them, or that the proprietors were awaiting trial. According to my mind, the suppression of smoke can be very readily accomplished if you put it where it belongs, in the health department. If your chief inspector has half a dozen or a dozen good men to assist him, he can very soon pick out the offenders, and inside of six months there will not be conditions [applause] such as confront us all in a short walk through this old New England city, which, as I recollect it, as I saw it ten years ago, was as little smoke and soot ridden as New York is to-day.

The CHAIRMAN.— Is there any question to be asked or further remarks to be made? If not, our time being limited, we must proceed to the next article on the programme, the report of the Committee on Diphtheria Bacilli in Well Persons, by Dr. Chapin, of Providence.

Dr. CHAPIN, of Providence.— Mr. President, the report of the committee is divided into two parts. The first part deals with the question of what should be done with well persons who have diphtheria bacilli present in their throats or noses. The second part of the report deals more with the technical aspects of the question, and presents a tabulation of the results which were obtained from the investigations of our co-workers and the deductions made from them.

REPORT ON DIPHTHERIA BACILLI IN WELL PERSONS.

BY A COMMITTEE OF THE MASSACHUSETTS ASSOCIATION OF BOARDS OF HEALTH.

FIRST PART.

Executive.

Your committee, when first appointed, July, 1900, attempted by a circular letter to learn what was being done in different American cities with well persons infected with diphtheria bacilli, and what were the views of the health officers as to the proper methods of controlling such cases. A summary of the replies received was presented at the Association meeting held Jan. 24, 1901. The replies showed that in only two cities, Baltimore and Providence, was a systematic attempt made to isolate well persons carrying diphtheria bacilli, that this rule applied chiefly to members of families in which clinical diphtheria existed, and that in Baltimore it applied chiefly to the school children in such families.

It was found that few data were available concerning the occurrence of diphtheria bacilli in well persons; and it was deemed advisable to institute, on a co-operative basis, an extended series of observations which would give us more accurate knowledge on this point. A circular letter asking for such co-operation was sent to about twenty bacteriologists. A number of favorable replies were received, and the following-named actually entered into the work: —

Boston, Mass	Dr. H. W. Hill and Mr. B. R. Rickards, with Dr. A. A. Taft and Drs. D. N. Blakely, W. S. Boardman, Paul Carson, John Duff, Theo. C. Erb, C. O. Kepler, C. Morton Smith, John T. Sullivan, and A. A. Wheeler.
Brookline, Mass.	Dr. F. P. Denny.
Lowell, Mass.	Dr. T. B. Smith.
Minnesota	Drs. F. F. Wesbrook, L. B. Wilson, O. Mc-Daniel and E. H. Bechman.
Newton, Mass.	Dr. Arthur Hudson.
New York City	Dr. W. H. Park, with Dr. A. C. Williams.

Ontario, Canada	Dr. J. A. Amyot.
Providence, R. I.	Dr. C. V. Chapin and Prof. F. P. Gorham.
Springfield, Mass.	Dr. H. C. Emerson.
Waltham, Mass.	Dr. C. A. Willis, with Drs. W. E. Fernald, I. H. Ladd, and George L. Wallace.
Washington, D.C.	Dr. W. C. Woodward and Dr. John E. Walsh.
Willard State Hospital, N.Y.,	Dr. W. A. Macy and Dr. Erving Holley.

The Association will doubtless join the committee in expressing their thanks to those who, though some of them not members of the Association, so willingly assisted us in our undertaking.

The results of these investigations are given in detail in the second part of this report.

Prevalence of Diphtheria Bacilli in Well Persons.

Of the questions before the committee, the first which they have attempted to answer is, how frequently diphtheria bacilli are found in well persons.

All observers are not in accord as to the morphological appearances which are to be considered as characteristic of this organism. Some agree with Wesbrook in the belief that diphtheria bacilli are found to present all the forms named by him. Others admit the validity of only a portion of these types. Some do not believe that the so-called pseudo-diphtheria bacillus, the short solid-staining type, is a true diphtheria bacillus, while others are entirely satisfied that it should be classed with *B. diphtheriæ*.

In order to answer, from our collected data, the question of the degree of prevalence of diphtheria bacilli in well persons, we may allow the different observers to state for themselves how many of their cultures they would, in the vernacular of the laboratory, have reported as "positive." Not all responded to this request. (See Tables I and II.)

In Boston, about 1 per cent. were considered positive; in Brookline, 2.3 per cent.; in Lowell, 1.2 per cent.; in Springfield, 1.6 per cent.; in Providence, 9 per cent. (see Footnote, Table I); and, in the District of Columbia, 22 per cent. These figures are chiefly interesting as indicating the divergent views of bacteriologists, and as explaining the widely different results hitherto obtained by dif-

ferent observers; although it is probable that the actual prevalence itself varies in different places to some extent.

Another way of stating the results of this work was for the committee to assume that certain forms would, by the majority of bacteriologists, be considered as diphtheria bacilli. The forms which we think would usually pass as diphtheria bacilli are Wesbrook's A, C and D. On this basis we found that 2.89 per cent. of the total persons examined (nose and throat) were infected with diphtheria bacilli, or, leaving out the returns from Minnesota, 1.39 per cent. It may be observed that the number reported positive did not correspond in all cases with the number of persons showing A, C, D (Tables I and II).

The bacteriological examinations made by members of the committee and those who worked with them, except certain cases classified as "special", not included in the main tables, and many of the Minnesota results, were confined to persons who had not, so far as known, been recently exposed to diphtheria. When examination is made of the throats of those who have recently been in more or less direct contact with diphtheria, infection is found more frequently. No observations on this point were undertaken by the committee; but, from the investigations of Chapin, Denny, Kober and Park, it is probable that from 8 to 50 per cent. of the well persons in families where there is diphtheria are infected with the bacilli.

In institutions, particularly institutions for children, where diphtheria has prevailed, the infection appears often to become more general; and a considerable number of the children will often be found to have diphtheria bacilli in their throats or noses. Occasionally cases of true diphtheria develop, or perhaps marked outbreaks occur. Wesbrook reports such a condition in a school at Owatonna, Minn., and in Bethany Home, Minneapolis; a similar experience was met with in an orphan asylum in Providence. It is to be noted that the types on which this wide distribution was determined included many others besides A, C and D, and that the diagnosis of a large part of the infection observed was based on the presence of the solid forms.

The committee feels justified in the inference that, in urban communities, at least 1 to 2 per cent. of well persons among the general

public are infected with the types A, C and D, and that where well persons are exposed to diphtheria, as in families, schools, or institutions where cases exist, the number infected is much larger, and may range from 8 to 50 per cent.

The estimates just given in the last paragraph refer to the prevalence of the typical granular types of diphtheria bacilli. If the solid and barred types be also forms of this organism, it is very much more widely distributed than is above assumed. The question as to what should properly be considered diphtheria bacilli is discussed at length in the second portion of the report.

Virulence of the Diphtheria Bacillus as Found in Well Persons.

There is no doubt that even the most typical forms of the diphtheria bacillus vary greatly in virulence and power to produce toxins. Oftentimes cultures will produce no constitutional symptoms when injected into guinea pigs; and, as is well known, persons with morphologically typical bacilli in their throats may remain free from all clinical symptoms, and may mingle freely with others without spreading the disease.

It would be of decided advantage to know whether the bacilli found in well persons are usually virulent or not. There are two ways of determining this.

A. By the Guinea Pig Test.

The probable value of this test and the method of its application will be discussed in the second part of the report. Suffice it to say here that a sufficient number of tests have not been reported to the committee on which to base any very general conclusions. However, those that have been reported resulted as follows (Table XII): forty-seven pure cultures of Wesbrook's types A, C and D, obtained from well persons were inoculated into guinea pigs. Of these, 17 per cent. were virulent. Of the types other than A, C and D, thirty-nine inoculations were made; and 7.5 per cent. proved to be virulent. All these latter positive results were from Providence. Gorham was the only observer to report virulent pure cultures of the solid-staining types C^2 or D^2. Wesbrook also at times has found

these types virulent, but made no virulence tests in this particular investigation.

B. By Clinical Evidence.

We may perhaps learn from clinical experience whether well persons with bacilli in their noses or throats do really give the disease to others. A number of our correspondents have reported instances in which it seems very certain that this was the case. (Preliminary Report: Journal Massachusetts Association Boards of Health, January, 1901.) On the other hand, it may be argued that the bacilli carried by well persons are frequently, perhaps most frequently, non-virulent for two reasons: first, the persons themselves are not sick; and, second, diphtheria is not so common as it would be, were virulent bacilli constantly distributed by the considerable number of infected well persons. If immunity, natural or acquired, be as wide-spread as stated by some authorities, these reasons would of course lose their weight.

We seem to be justified in concluding from an examination of the experimental and clinical evidence at hand that only a small percentage of the morphologically typical diphtheria bacilli found in well persons not recently exposed to the disease are virulent; but the number of infected individuals well enough to mingle freely with others is so great that, even if only a small proportion of them be likely to transmit the disease, we have in them a very important factor in the spread of diphtheria.

Danger of Infection from Healthy Persons.

The danger from a healthy person depends on the age, the habits, the surroundings, the occupation, and the intelligence of the infected person.

A child who is constantly putting its hands and everything else into its mouth, and who plays with susceptible children of similar habits, is more likely to spread the disease than an adult. Infected individuals of cleanly habits are less likely to disseminate bacilli than the uncleanly.

The danger from an infected person depends also on his surroundings, whether he comes in contact with other individuals in such

a way that he is likely to infect them. Thus in a crowded tenement the opportunity for spreading the infection is much greater than it is in a private house. In institutions, infected persons are much more likely to spread the disease than elsewhere.

The occupation of the individual is very important. Thus persons who are engaged in handling articles of food (like milkmen) and those whose work brings them in close contact with small children (like nurses) are more likely to spread the disease than day laborers or clerks.

The intelligence of a person should be considered. An intelligent person can easily be taught to take a few simple precautions which will greatly reduce the risk of infecting others, without imposing any serious restrictions upon him. The manner in which the infection is spread can be explained to him. He can be taught to sterilize everything which comes in contact with the secretions of his mouth or nose, and to avoid sneezing, coughing, or even talking toward and in close proximity with another person. A few simple precautions of this sort, carried out by an intelligent person, will greatly lessen the danger of infection.

The danger from the rooms occupied by a healthy infected person is very slight. It is probably no greater than that of an electric car or any other much frequented public place into which some infected persons are undoubtedly coming very often.

Conclusions.

In our conclusions we recognize that there are two classes of persons carrying diphtheria bacilli to be considered.

A.

There are scattered among the general public a considerable number of persons, not recently and directly exposed to the disease of diphtheria, who have typical diphtheria bacilli in their throats. Our observations show the average, for all places reporting, to be nearly as high as 3 per cent., or in the east 1.39 per cent. This would mean in Boston, if the smaller figure be used, about 8,000 such cases. The mere statement of this fact shows how entirely futile it is to

attempt to seek out and isolate the whole of this number. If this cannot be done, it is useless and unjust to isolate the small number that it may be possible to discover. We are therefore led to adopt the following as our first conclusion: —

CONCLUSION I. IT IS IMPRACTICABLE TO ISOLATE WELL PERSONS INFECTED WITH DIPHTHERIA BACILLI, IF SUCH PERSONS HAVE NOT, SO FAR AS KNOWN, BEEN RECENTLY EXPOSED TO THE DISEASE.

If it happens that such cases come to the knowledge of the health officer, it would, however, be wise to give instructions in regard to caring for the secretions, thus placing a part of the responsibility of the case upon the infected person himself.

B.

We may assume, and with some show of probability, that the bacilli in well persons recently exposed to diphtheria, are more likely to be virulent than are others, and we might attempt to isolate all members of families where diphtheria exists, so long as the bacilli are found in the throat or nose; but there are difficulties in the way. Such a procedure would, in many cases, lengthen the period of the family isolation, and prove most exasperating to the family and to the medical attendant. Wage-earners, business and professional men, would be kept at home and away from important work. It is difficult to maintain the isolation of the patient during a long convalescence; but it is far more difficult to isolate a person who has not been sick at all. It is very difficult to persuade a man that he should remain at home because he has diphtheria bacilli in his throat, when one is obliged, in answer to his inquiry, to admit that there are hundreds of others going freely about, although infected like himself. It is usually useless to try to tell him that the conditions are different in his case, that his bacilli are derived from a recent case, and have been proved virulent. He will not accept the reasoning, and very likely his medical adviser will not accept it.

If, instead of a single throat culture, as is required in most places, two successive negatives from nose and throat are made necessary for release, the difficulties will be still further increased; and, if two

negatives are not required, many infected will escape, and the object of the whole procedure will be defeated.*

Since the number of persons among the general public who are infected with diphtheria bacilli and who pass unrecognized and unrestrained may at any one time be greater than the number of infected persons in diphtheria families, it does not seem to be expedient to place restrictions upon the latter except when it can be done without causing much friction or hardship, or unless the danger in any particular instance can be shown to be very considerable.

We are therefore led to our second conclusion: —

CONCLUSION II. IT IS NOT ADVISABLE AS A MATTER OF ROUTINE TO ISOLATE FROM THE PUBLIC ALL THE WELL PERSONS IN INFECTED FAMILIES, SCHOOLS, AND INSTITUTIONS.

It is advisable to keep the children in infected families away from day-school, Sunday-school, and all public places, and that they should remain on their own premises, if possible.

Wage-earners may usually be allowed to continue their work; but teachers, nurses, and others who are brought in close contact with children should not be allowed to do so. Milkmen should not be allowed to continue their business.

When it is proposed to remove a well person from an infected family, it is not advisable to make the removal if diphtheria bacilli are present.

In schools and institutions it is usually advisable, if the infection is not too wide-spread, to separate from the others all infected persons, sick or well.

When diphtheria appears in a community which has for some time been free from it, it is advisable to isolate all persons who have been brought in contact with the patient until it shall have been shown that they are free from diphtheria bacilli.

While believing that it is not possible in the majority of cases to

*This method of keeping at home those members of families in which diphtheria exists who are infected with diphtheria bacilli was carried out very faithfully in Providence for a period of five years, but has been abandoned because it met with very decided opposition from both the laity and the medical profession; it should be noted that in Providence only one throat negative was required for release.

isolate well persons infected with diphtheria bacilli, we believe that the attempt should be made to educate the public to care for their persons and their secretions, so as to avoid, as much as possible, the danger of infecting themselves or others. We would again call attention to the suggestions made at a former meeting for teaching cleanliness to school-children, and similar advice might be profitably given to the members of families where diphtheria exists.

In thus putting before the Association the results of both practical and experimental work concerning diphtheria bacilli in well persons, we do not wish to be understood as minimizing in any way the possible danger of bacilli-carriers to their environment. We have simply recommended what appears to be the most expedient course to pursue after considering the various conflicting interests of the public and the infected individual. The responsibility is largely shifted to the latter, and in the case of intelligent persons the individual responsibility in disseminating disease should be clearly placed before the infected person.

The various local health authorities, in accepting these suggestions, must necessarily exercise increased care, watchfulness and discrimination, and should be prepared at any time whenever special circumstances warrant it to isolate any and all persons who are discovered with presumably virulent diphtheria bacilli.

The technical portion of the report, including the tabular presentation of the results of the observations of our co-workers, has been prepared by the bacteriologists of the committee. Dr. Denny has that part of the report, and I will ask him to read it.

The CHAIRMAN.— While so many are present, I want to call attention to the fact that it has been moved and seconded that a vote of thanks of this Association be tendered for the excellent paper by Mr. Warren, of Boston, and also for the excellent detailed account of the work in New York City upon the smoke nuisance by Mr. Raynor.

The motion was adopted.

The CHAIRMAN.— Dr. Denny will read the remaining portion of the report.

Dr. DENNY.— Mr. President and gentlemen, I have here the second part of the report, which has been prepared by the bacteriologists of the committee. Dr. Theobald Smith has written an introduction to this part of the report, which I will read.

SECOND PART.

BACTERIOLOGICAL.

The fact that diphtheria bacilli may, and frequently do, persist in the throat and nose of patients some time after recovery, and that even persons not clinically diseased may, in certain instances and for a variable period of time, harbor virulent bacilli, is entirely in harmony with our knowledge concerning the relation of disease germs to the individuals liable to their attack.

Before discussing its significance more in detail, we may state that the causal relation of the Klebs-Loeffler bacillus to what is clinically known as diphtheria is as firmly established as that of any of our well-known pathogenic bacteria to their respective diseases. This is based on the following facts : —

1. The Klebs-Loeffler bacillus is the only species regularly present in diphtheria. It is most abundant at the height of the disease, and disappears soon after convalescence.

2. This bacillus produces a poisonous substance, or toxin, which after injection into animals produces inflammatory and hæmorrhagic œdemas, necrosis, or sloughing of tissues, and paralysis.

3. The antitoxin produced by the injection of the toxin is specifically preventive and curative.

The popular conception that disease germs enter, permeate, and then pass out of the body like an orderly army without stragglers, is not confirmed by observation or experiment. There are two opposing forces in every infectious disease, and the variation in the resistance of the individual and in the virulence of the bacteria make the resultant disease a very variable quantity. The same is true of the final exit and destruction of bacteria after recovery, and leads to the inference, proved in a variety of diseases, that persons, to all appearances well, may carry disease germs. There is no basis for

the belief that such bacteria are necessarily non-virulent. Their harmlessness to the carrier may simply be an expression of his immunity, either inherited, or acquired at some earlier period through disease. Laboratory tests show clearly that such microbes, when identified as belonging to one or the other species of pathogenic bacteria, are, as a rule, of the usual virulence.

These organisms are frequently carried in such a way as to be easily shed, and hence to be a source of danger to others. Thus in chronic pulmonary tuberculosis a person may for years expectorate immense numbers of tubercle bacilli. In individuals who have recovered from typhoid fever the fæces, and particularly the urine, may contain typhoid bacilli for a time. Mild cases of typhoid, not recognized, may lead to epidemics. In Asiatic cholera the spirilla have been found in the stools of well persons living within the infected area. It is probable that in influenza the microbe may vegetate on the mucous membrane for some time after recovery. Lastly, it has been known for over twenty years that the diplococcus of croupous pneumonia flourishes on the mucous membrane of the throat of certain persons.

If we consider for a moment this list of pathogenic bacteria likely to survive the disease they produce, we find that they peculiarly represent those maladies having a starting-point, or producing lesions, in the mucous membranes. The diphtheria bacillus vegetates chiefly on the surface, sending its toxin inward, and this localization of the bacilli gives them a special opportunity to escape destruction by the body and to vegetate in immune individuals for a time. In fact, we need not be surprised if in the future more persons shall be found carrying these bacilli than the present figures indicate.

As there is no sharp line to be drawn between the healthy and the diseased state, one shading imperceptibly into the other, so there is no sharp line to be drawn, for many infections at least, between the time when the micro-organisms are still in the body and when they have all been destroyed or eliminated. It follows logically, as is shown by the work of certain members of this committee, that well persons may be at times the source of infectious diseases.

In the capacity of bacteriologists it becomes our duty to emphasize the facts, that well persons may be the source of virulent disease

germs, and that public-health authorities cannot concentrate their attention on health and disease as such, but must take cognizance first and foremost of the whereabouts of disease germs; and in so doing they practically admit that the carrier of such germs, even if well, may be fitly compared to the spark which may or may not start a conflagration.

The measures to be carried out in dealing with individual carriers, when discovered, must be left for the health officers to devise. Such measures will naturally depend on the relative dangerousness of the disease involved, on the relative ease with which the bacteria may be disseminated, and, in fact, upon a number of conditions which do not come within the scope of the bacteriologist, but which must be settled on purely practical grounds.

Technical Results.

The following is a report of the results of the investigations which have been carried out by the committee, together with a simple statement of our present knowledge of the diphtheria bacilli found in healthy persons.

The chief objects of the investigations have been to determine: first, the frequency of the different forms of diphtheria-like bacilli in healthy persons, and, second, the virulence of the different forms.

A number of laboratory workers were asked to examine separate cultures from the nose and throat of healthy persons, to record, according to Wesbrook's classification, all the diphtheria-like bacilli which were found, to state whether or not they would report the cultures containing such forms as positive or negative if the cultures were taken for release, and finally to isolate these forms in pure culture and to test their virulence on guinea pigs.

The number of persons which have been examined and so recorded that they could be classified on the basis intended, is 3,953. They were as follows: —

1. In the Minnesota State Board of Health Laboratory in Minneapolis, 1,154 children and adults in institutions.

2. In the Boston Board of Health Laboratory, 892 adults in prison and pauper institutions.

3. In the Providence Board of Health Laboratory, 541 school children, 376 tramps, 10 small-pox patients. Total, 927.

4. In the Lowell Board of Health Laboratory, 250 cotton-mill hands.

5. In Washington, 205 children and adults in a hospital, and 16 health department officials. Total, 221.

6. In Springfield, 64 school children, 121 male prisoners in jail. Total, 185.

7. In the Brookline Board of Health Laboratory, 129 school children.

8. In the Willard State Hospital for the Insane, 82 inmates.

9. In the Newton Board of Health Laboratory, 63 women students at Wellesley College.

10. In Ontario, 50 patients and attendants in a general hospital.

The virulence of the bacilli in 86 cultures was tested.

In addition to the above, cultures from 1,536 persons were taken in Boston, Brookline, New York and Waltham; but from the incompleteness of their records they could not be classified with the others, and are therefore grouped together under the head of "special cases." (Footnote, Table II.)

The committee had hoped to have larger and more complete returns, and especially a larger number of examinations of persons living outside of institutions. Insufficient time and the inability to get permission to make cultures were the causes of this deficiency.

The work of tabulating the returns to show the relative frequency with which the different types were found in different places and in different classes of cases was very great, and was done by the secretary of the committee, Dr. Hibbert Winslow Hill. The tables in their final form were made largely by Dr. F. F. Wesbrook, who gave much time to this work.

The results of the work will be found summarized in the tables. In order to make them clear, a few words in explanation of Wesbrook's classification of types of *B. diphtheriæ* will be necessary.

Wesbrook's Classification.— Wesbrook divides all the forms of diphtheria bacilli into three groups, according to their staining reactions. Those with deeply-staining granules he calls "*granular forms*," those with transverse bands "*barred forms*," and those stain-

ing evenly "*solid forms.*" He further divides each of the groups into seven types according to shape and size. The types are designated by the letters A to G. Each individual type of the granular group is designated by a simple letter, A, B, C, etc.; the barred forms are called A^1, B^1, C^1, etc.; the solid forms are A^2, B^2, C^2, etc. The types are progressively smaller from A to G in each group.

The different types have been very well represented in plates which were published with Wesbrook's original article.* Through the courtesy of Dr. Wesbrook all the workers were furnished with these plates, so that they might be kept before them while making the examinations. In every culture showing diphtheria-like bacilli the forms present were recorded according to Wesbrook's types on charts which had been arranged by Dr. Wesbrook. We have found this classification to be a very rational one and very helpful in the work. It has made possible a comparison of results which could not have been accomplished in any other way. The difficulty in comparing the results hitherto obtained by different investigators has been that they have not classed as diphtheria bacilli the same types of bacilli. By the method of recording the types present, irrespective of personal views as to the propriety of classing the forms as true diphtheria bacilli, the question of what forms to consider as *B. diphtheriæ* is left to those who may make use of the results. The personal equation may thus be eliminated to a great extent.

This method has also given an opportunity to compare the relative frequency of the different forms of bacilli in different localities. The differences in some instances have been striking. The most marked are found between the results obtained in Minnesota and those in the laboratories in the east. While almost all the forms were more prevalent in Minnesota, the contrast is especially marked in the granular forms A, C and D, which are nine to ten times as frequent there as they are in the east.

In considering such differences, allowance must be made for three variables: —

1. The *personal equation* of the observer, under which must be included *technique* of preparation, and *classification.*

* Transactions of the Association of American Physicians, 1900. Also see Minnesota State Board of Health Report, 1899–1900.

2. The individuals from whom the specimens were obtained; whether they had been recently exposed to diphtheria or not; whether they were massed in such a way as to facilitate exchange of nose and throat contents.

3. Actual differences in locality, with the variables in conditions incident to this alone.

In the Minnesota examinations, cultures were taken almost altogether from children in *institutions* in which diphtheria had existed from one to eighteen months previously. This was unavoidable at the time when the investigations were asked for. It seems worthy of remark that in 316 *day-school children* (Park Rapids), from whom cultures were taken at the beginning of school in September, in a town where diphtheria had existed for eighteen months (this constituting the reason for the examination), the percentage of infection with types C, D and A, was higher than that found in the east, and higher than in Brookline, where the 129 examinations listed were made under somewhat parallel conditions. It was, however, lower than that found in the other Minnesota examinations, except in a wholly diphtheria-free institution (Catholic Orphan Asylum) where the per cent. affected approximated that found in Boston. This seems to bear directly on infection in general, indicating that infection is much more apt to be widespread amongst children in institutions than in day-school children.

As a further illustration of this variation of types in different localities, the results of the examinations of throat cultures by the New York City Board of Health (see Table II, etc.) show even a higher percentage of infection with the more generally recognized types of *B. diphtheriæ* (C. D and A) than Minnesota. There had been more or less exposure in this case also. Further examples are afforded by three observations along somewhat different lines. (1) Gorham found that the types present in Providence in clinical diphtheria ran very considerably smaller than those in Boston (Hill) when actual comparison was made under similar conditions. (2) Wilson of Minnesota found branching forms of *B. diphtheriæ* in abundance in Boston, although they have been seen only three times in Minnesota. (3) Amyot of Ontario states that the types vary with the locality to some extent, since, in studying clinical cases bacteriologically, he

was able to distinguish between two specific localities by the types present.

The results in Minnesota were so at variance with those obtained here that it seemed best to arrange them separately in the tables, particularly as this report was intended primarily for the use of Massachusetts boards of health.*

Frequency of the Occurrence of Wesbrook's Types of Bacilli in Healthy Persons, and a Consideration of the Evidence for their Relation to Diphtheria Bacilli.

Granular Forms.— A, C and D are the forms most commonly present in clinical diphtheria,† and would be classed as diphtheria bacilli by all bacteriologists. One or more of these three forms were present in the nose in .93 per cent. of persons examined in the east, or, including Minnesota, in 2.07 per cent. In the throat they were present in .61 per cent., or 1.46 per cent. with Minnesota. Of all *persons* examined in the east, 1.39 per cent. had these forms present in either throat or nose or both, or 2.89 per cent., including Minnesota. The other granular forms, B, E, F and G, were seldom found in the east. Their relation to diphtheria bacilli is not settled. (Tables I and II.)

Barred Forms.— These are said to be the only forms present in some clinical cases; but this condition must be rare, since some of the committee have never met such a case. They are said to be frequently present in the eye, where they are called the xerosis bacillus. If present in the eye, they can very easily pass through the lachrymal duct to the nose.

Solid Forms.— The bacilli of this group have protoplasm, which stains uniformly, and shows neither granules nor bars. In group A^2, B^2 and C^2 the rods occur singly; while D^2, E^2, F^2 and G^2 appear to be in pairs, often resembling two triangular or cone-shaped bodies

* That the basis of opinion afforded by presence of types in actual practice in Minnesota is not different from that in other localities, is shown by the fact that the average duration of the quarantine period determined by the absence of diphtheria bacilli in two consecutive negative examinations is not greater in Minnesota than that in other localities.

† See also statistics of occurrence of A, C, D in clinical cases, Table XIII; also, Minnesota State Board of Health Report, 1899–1900.

with their bases together. These forms are found very frequently in the nose, as will be seen by an examination of the tables. For example, D^2 was present in the nose in 16.7 per cent. of persons in the east, and 21.8 per cent., including Minnesota.

The relation of these solid types to diphtheria bacilli is still unsettled. They are sometimes met with as variants in pure cultures of diphtheria bacilli. Wesbrook and Gorham claim to have found them present alone in cases of clinical diphtheria. Both of these observers several times isolated solid forms in pure cultures from healthy persons, and proved them virulent to guinea pigs. Such a condition, however, must be very rare, as no other members of the committee have ever found these forms present alone in clinical diphtheria; and, when isolated by them from healthy persons, they have always proved to be non-virulent. Certain of the solid forms have characteristics which have been considered sufficient to differentiate them from *B. diphtheriæ*. Thus, while the typical diphtheria bacillus has a very marked power of producing acid in dextrose bouillon, this property is entirely, or, at least, very often, absent in the most abundant solid forms, certainly those of the D^2 type. For this reason the solid forms are considered by many authorities not to be diphtheria bacilli at all, and are classed as pseudo-diphtheria bacilli or Hoffman's bacillus.

Others consider that these differences are not sufficient to separate them from true diphtheria bacilli. Thus Gorham believes that the changes in morphology are brought about by the action of the body fluids of an immune individual. Both he and Wesbrook find a gradual change from the granular to the solid forms during convalescence from the disease.

What Types should be regarded as Diphtheria Bacilli? — The committee believes that the question of the relation of these types to clinical diphtheria requires more investigation. The following statements, however, seem justified from the available evidence.

The large granular types are the ones most commonly present in cases of clinical diphtheria. They are found in about 1 to 2 per cent. of well persons in this vicinity. The solid forms are very seldom present alone in cases of diphtheria, while they were found in about 20 to 25 per cent. of all healthy persons. It is evident,

therefore, that the granular types are the most important ones in the causation of diphtheria.

Whatever the relation of the solid types to diphtheria, whether they be true diphtheria bacilli or not, it is very obvious that they can be of little diagnostic value, being present as they are in so large a percentage of all healthy persons. Any attempt to base isolation on the presence of such types would be an injustice. Certainly, no restrictions whatever should be put upon a healthy person unless there are present in his nose or throat the forms of bacilli morphologically identical with those commonly seen in cases of diphtheria. In healthy persons, therefore, usually only the granular types, **A, C** and D should be recognized as diphtheria bacilli. We believe that the persons in whom these three forms are present represent almost all the individuals who are capable of infecting others.

It seems probable, in view of the results obtained by such reliable observers as Wesbrook and Gorham, that sometimes the solid forms, even when present alone, are true diphtheria bacilli; but we believe that this is so seldom the case that the number of persons who might be overlooked by neglecting these types would be very small.

The percentage of persons having the forms A, C or D in the throat or nose is, as already stated, 1.39 per cent. in the east, and 2.89 per cent., including Minnesota. These figures probably are not constant. Cultures from different classes of people would sometimes show different results. The results might be expected to vary in different years, depending in part on the prevalence of the disease of diphtheria and in part on factors as yet unknown. It might be said that at the time these investigations were made (1901) diphtheria had been unusually prevalent. It seems reasonable, however, to suppose that in Massachusetts about 1 to 2 per cent. of all persons carry typical diphtheria bacilli. Of this 1 to 2 per cent., not all are capable of transmitting the disease; for it is found that bacilli morphologically identical with diphtheria bacilli may have no power of producing toxins.

Virulence of the Diphtheria Bacilli Found in Healthy Persons.

As there are differences of opinion in regard to the value of the guinea pig test for virulence, due in part to a misunderstanding of the nature of the test, a word in explanation of the method employed seems desirable.

The test is usually made by growing the diphtheria bacilli in bouillon. Soluble toxins are formed in the bouillon, if the bacilli are virulent; and this bouillon inoculated into guinea pigs produces local lesions and the death of the animal, even if all the bacilli have been removed by filtration. The test, therefore, is not to see if the bacilli produce toxins in the guinea pig, but whether they will produce them in the bouillon. If there are toxins in the bouillon, we know that they will produce the characteristic lesions in the guinea pig; for the effect of the diphtheria toxins on guinea pigs is so constant that this animal is taken as a standard of measure of the strength of diphtheria toxins and antitoxins. Practically, all diphtheria bacilli from clinical cases produce toxins in bouillon; and there is no reason to believe — although this cannot be proved — that the converse is not true,— namely, that the bacilli which produce no toxins in bouillon will not produce them in human beings.

The number of virulence tests which were made in connection with these investigations was, unfortunately, small. More information on this point is needed.

Thirty-eight cultures of the *solid forms* were tested. In thirty-five the results were negative, while three showed virulence. The three positive tests were obtained by Gorham, reference to whose results has already been made.

One test of the *barred forms* was made. The result was negative.

Forty-seven tests of the *granular forms* were made. Thirty-nine proved to be non-virulent, eight (about 17 per cent.) were virulent.

While these investigations show that about 1 to 2 per cent. of all persons have typical Klebs-Loeffler bacilli, only about 17 per cent. of this 1 to 2 per cent. have virulent bacilli, or, in other words, 17 in 5,000 to 10,000 of all persons have diphtheria bacilli which are dangerous to the public health. The number of virulence tests

was too small to make the above percentages of much value, yet they bring out the fact that, if a healthy person is found to have Klebs-Loeffler bacilli, and there is no connection traceable between that person and cases of diphtheria, the chances are very much in favor of the bacilli being non-virulent. Great care should therefore be taken, we believe, not to put unnecessary restrictions on persons where the chances are great that the bacilli are non-virulent.

Diphtheria Bacilli in Persons Exposed to the Disease.

The investigations of the committee, except as already noted, do not cover the frequency of occurrence of diphtheria bacilli in exposed persons, but observations on this point are obtainable. Thus Park * found 50 per cent. of children exposed in New York tenements to have Klebs-Loeffler bacilli. Chapin,† in Providence, finds 16 per cent. of exposed persons to have the bacilli; Denny, ‡ in Brookline, 13 per cent.; Kober,§ in Breslau, 8 per cent.

It is found also that the bacilli in persons who have been in close contact with diphtheria are usually virulent. Thus Park in six cultures from exposed persons, Kober in fifteen, and Denny in seven, found all to be virulent.

From the above it is evident that the problem of what to do with a person who has been exposed to diphtheria is very different from what it is in the case of a non-exposed individual.

The bacilli found in healthy exposed persons are probably of the same virulence as those in the diseased individual, the absence of symptoms in the former being the result of an acquired or artificially produced immunity. A healthy person who has Klebs-Loeffler bacilli as a result of recent exposure is therefore as dangerous as a convalescent from diphtheria in whom the bacilli are persisting after all the local symptoms have disappeared.

It is therefore theoretically rational, if convalescents are isolated, to isolate also all healthy infected persons who have been exposed,

* American Text-book Practical Medicine, vol. i. p. 647.

† Reports of Superintendent of Health, Providence, R.I.

‡ Board of Health Report of Brookline, Mass., 1900.

§ Kober, Zeitschrift f. Hygiene, 1899, Bd. xxxi.

until they are free from bacilli. Such a course would undoubtedly result in preventing the occurrence of some cases and in saving some lives. It is found, however, that such a course is not practicable for all boards of health to follow. It is largely an economic question. The risk to the public health must be weighed against the loss and privation to the individual from isolation.

(Signed)

CHARLES V. CHAPIN,
Superintendent of Health, Providence, R.I., Chairman of the Committee.

HIBBERT WINSLOW HILL,
Bacteriologist, Boston (Mass.) Board of Health, Secretary of the Committee.

SAMUEL W. ABBOTT,
Secretary, Massachusetts State Board of Health.

F. H. BAKER,
Bacteriologist, Worcester (Mass.) Board of Health.

FRANCIS P. DENNY,
Bacteriologist, Brookline (Mass.) Board of Health; Assistant in Bacteriology, Harvard University.

FREDERIC P. GORHAM,
Bacteriologist, Providence (R.I.) Board of Health; Associate Professor of Biology, Brown University.

WILLIAM H. GOVE,
Salem (Mass.) Board of Health.

ARTHUR HUDSON,
Bacteriologist, Newton (Mass.) Board of Health.

THOMAS B. SHEA,
Chief Medical Inspector, Boston (Mass.) Board of Health.

THEOBALD SMITH,
Bacteriologist, Massachusetts State Board of Health; Professor of Comparative Pathology, Harvard University.

F. F. WESBROOK,
Bacteriologist, Minnesota State Board of Health; Professor of Pathology and Bacteriology, University of Minnesota.

(Dr. Wesbrook modifies his assent as follows: for Conclusion II. he would substitute, "It may sometimes be impracticable to isolate from the public all the well persons in infected families, schools, and institutions, though it should be done as a routine if at all possible." He also adds, "Sometimes it is necessary to isolate, at least temporarily, patients who have sore throats in which types of bacilli not represented by A, C, and D are present.")

Tables showing the results of the work done are appended.

TABLE I.

SHOWING PERSONS INFECTED WITH A, C, D ("TYPICAL *B. diphtheriæ*").

	Ontario.	Newton, Mass.	Willard State Hospital, N.Y.	Brookline, Mass.	Springfield, Mass.	Washington, D.C.	Lowell, Mass.	Waltham, Mass.	Providence, R.I.	Boston, Mass.	TOTAL IN EAST.	MINNESOTA. Bethany Hospital.	Old Ladies' Home.	Owatonna.	Red Wing.	Catholic Orphan Asylum.	Park Rapids School.	TOTAL IN MINNESOTA.	GRAND TOTAL.
Nose only.																			
A	0	0	0	0	0	0	0	0	2	2	4	1	0	1	0	0	1	3	7
C	0	0	0	0	0	0	0	0	2	2	4	0	1	1	0	0	0	2	6
D	0	0	2	0	0	0	1	1	0	8	12	6	0	2	0	0	6	14	26
A, C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
A, D	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	2	2
C, D	0	0	0	1	0	0	1	1	0	1	4	2	0	1	3	1	2	9	13
A, C, D	0	0	0	0	0	0	0	0	0	0	0	1	2	1	2	0	0	6	6
Total nose only	0	0	2	1	0	0	2	2	4	13	**24**	11	3	6	5	1	11	**37**	61
Throat only.																			
A	0	0	0	0	0	0	0	0	0	3	3	0	0	0	0	0	0	0	3
C	0	0	0	0	0	1	0	0	0	2	3	0	0	0	0	0	0	0	3
D	0	0	0	0	0	1	0	0	0	2	3	1	1	0	3	1	2	8	11
A, C	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
A, D	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	1	1	3
C, D	0	0	1	0	0	0	0	0	0	1	2	2	0	2	1	0	0	5	7
A, C, D	0	0	0	0	0	0	0	0	0	0	0	1	1	1	3	0	2	7	7
Total throat only	0	0	1	1	0	2	0	0	0	10	**14**	4	2	3	6	1	5	**21**	35
Nose and Throat.																			
A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C	0	0	0	0	0	0	0	0	0	1	1	0	0	2	0	0	0	2	3
D	0	0	0	0	0	0	0	0	0	3	3	0	0	0	0	0	0	0	3
A, C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A, D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C, D	0	0	0	0	0	0	0	0	0	0	0	4	0	1	3	0	0	8	8
A, C, D	0	0	0	1	0	0	0	0	0	0	1	2	0	1	8	0	1	12	13
Total nose and throat	0	0	0	1	0	0	0	0	0	4	**5**	6	0	4	11	0	1	**22**	27
Grand total (A, C, D)	0	0	3	3	0	2	2	2	4	27*	**43**	21	5	13	22	2	17	**80**	123
Reported positive	0	0	3	3	3	50*	3	3	84*	9					not	giv	en		
Total persons examined,	50	63	82	129	185	221	250	297	927	892	**3,096**	102	42	247	382	65	316	**1,154**	4,250

*The Providence results show particularly well how varied the numbers reported as "positive" may be according to the types regarded as important. Thus on the basis of the committee's belief that A, C, D, should be considered chiefly or solely, Providence would show .43% positives. If all granular and barred but not solid forms be included, as Professor Gorham, of Providence, states there would be about 3% positives. If all forms be included, there would be about 25%. The number actually reported makes about 9%. In Washington the positives formed .9% on the committee's standard; but 22% were actually reported positive. In Boston, on the committee's standard, 3.02% were positive; but only 1% were so reported.

TABLE II.

SHOWING PERCENTAGES OF PERSONS INFECTED WITH A, C, D ("TYPICAL *B. diphtheriæ*").

	Ontario.	Newton, Mass.	Willard State Hospital, N.Y.	Brookline, Mass.	Springfield, Mass.	Washington, D.C.	Lowell, Mass.	Waltham, Mass.	Providence, R.I.	Boston, Mass.	TOTAL IN EAST.	MINNESOTA.							GRAND TOTAL.
												Bethany Hospital.	Old Ladies' Home.	Owatonna.	Red Wing.	Catholic Orphan Asylum.	Park Rapids.	TOTAL IN MINNESOTA.	
Persons examined .	50	63	82	129*	185	221	250	297	927	892*	3,096	102	42	247	382	65	316	1,154	4,250
Percentage of total persons infected .	0	0	3.66	2.32	0	0.90	0.80	0.67	0.43	3.02	1.39	20.59	11.90	5.26	5.76	3.07	5.38	6.93	2.89
Percentage of persons showing nose only infected . .	0	0	2.44	0.77	0	0	0.80	0.67	0.43	1.45	.77	10.78	7.14	2.02	1.30	1.53	3.48	3.20	1.43
Percentage throat only infected . .	0	0	1.22	0.77	0	0.90	0	0	0	1.12	.45	3.92	4.76	1.01	1.59	1.53	1.58	1.82	0.82
Percentage both nose and throat infected . . .	0	0	0	0.77	0	0	0	0	0	0.45	.16	5.88	0	2.23	2.87	0	0.32	1.90	0.63
Percentage of persons showing nose infected with or without concurrent throat infection	0	0	2.44	1.54	0	0	0.80	0.67	0.43	1.90	.93	16.66	7.14	4.25	4.17	1.53	3.80	5.11	2.07
Percentage of persons showing throat infection with or without concurrent nose infection . . .	0	0	1.22	1.54	0	0.90	0	0	0	1.57	.61	9.80	4.76	3.24	4.46	1.53	1.90	3.72	1.46
Percentage reported positive . . .	0	0	3.66	2.32	1.62	22.6	1.20	1.00	9.06	1.01					not given				

* Some cases examined in Boston, Brookline, and New York, were omitted from this table because of certain omissions in their records.

The records permit, however, their addition here, which would make the percentages as follows: —

Boston: total examined (nose and throat, including 892 given above), 991; total infected (A, C, D), 2.82%; nose only, 1.41%; throat only, 1.01%; both, 0.41%: total persons with nose infected, 1.81%; total persons with throat infected, 1.41%; total reported positive, 10 = 1.01%.

Brookline (exclusive of 129 given above): nose and throat culture in same tube, 687; total infected (A, C, D), 17 = 2.47%: throat only examined, 253; total infected (A, C, D), 6 = 2.37%. All infected with A, C, D, were reported positive.

New York: throat only examined, 200; total infected (A, C, D), 13 = 6.5%. All infected with A, C, D, were reported positive.

The persons examined, as recorded above in the Willard State Hospital, and those given in the foot-note in Brookline and New York, as well as all except the Catholic Orphan Asylum in Minnesota, had been more or less exposed to diphtheria.

TABLE III.

SHOWING NUMBER OF TIMES EACH TYPE WAS FOUND IN A NOSE, THE CORRESPONDING THROAT BEING FREE OF ALL TYPES. *Since two or more types sometimes occurred in one nose, the total of times any one type was found does not correspond with the total noses infected.*

	Ontario.	Newton, Mass.	Willard State Hospital, N.Y.	Brookline, Mass.	Springfield, Mass.	Washington, D.C.	Lowell, Mass.	Waltham, Mass.	Providence, R.I.	Boston, Mass.	Minnesota.
A	0	None of the types reported.	0	0	0	0	0	Types not minutely recorded.	2	2	8
A^1	0		0	0	0	0	0		2	0	4
A^2	0		0	0	0	0	0		2	0	1
B	0		1	0	0	0	0		0	0	0
B^1	0		0	0	0	0	0		0	0	0
B^2	0		0	0	0	0	0		0	2	0
C	0		0	1	0	0	1		2	3	12
C^1	0		0	1	0	2	1		11	4	27
C^2	0		1	22	1	0	1		87	1	25
D	0		2	1	0	0	1		0	8	23
D^1	1		0	3	0	0	2		3	139	97
D^2	4		2	36	11	0	4		123	274	207
E	0		0	0	0	2	0		0	2	26
E^1	0		0	0	0	2	0		1	7	13
E^2	5		0	15	12	35	0		4	5	241
F	0		0	0	1	0	0		0	1	0
F^2	0		0	0	2	0	0		0	0	3
G	0		0	0	0	0	0		0	0	4
G^2	1		0	0	1	3	0		0	9	34
Total noses infected . (throat uninfected)	8	0	2	42	21	44	6	92	189	351	283
Total number examined,	50	63	82	129	185	221	250	297	927	892	1,154

TABLE IV.

SHOWING NUMBER OF TIMES EACH TYPE WAS FOUND IN A THROAT, THE CORRESPONDING NOSE BEING FREE OF ALL TYPES. (See italics, Table III.)

	Ontario.	Newton, Mass.	Willard State Hospital, N.Y.	Brookline, Mass.	Springfield, Mass.	Washington, D.C.	Lowell, Mass.	Waltham, Mass.	Providence, R.I.	Boston, Mass.	Minnesota.
A	0	None of the types reported.	0	1	0	0	0	Types not minutely recorded.	0	3	2
A^1	0		0	0	0	0	0		0	2	2
A^2	0		0	0	0	0	0		0	0	0
B	0		1	0	0	0	0		0	0	0
B^1	0		0	0	0	0	0		0	0	0
B^2	0		0	0	0	0	0		0	0	0
C	0		1	1	0	0	0		0	1	9
C^1	0		0	0	0	0	0		1	0	4
C^2	0		0	1	1	0	0		11	0	1
D	0		1	0	0	1	0		0	3	14
D^1	0		0	0	0	0	0		0	1	13
D^2	1		0	3	11	0	0		2	5	33
E	0		0	0	0	0	0		0	0	9
E^1	0		0	0	1	0	0		0	0	0
E^2	0		0	1	9	3	0		0	0	36
F	0		0	0	0	1	0		0	0	2
F^2	0		0	0	0	0	0		0	0	1
G	0		0	0	0	0	0		0	0	3
G^2	0		0	0	1	0	0		0	1	4
Total throats infected (noses uninfected)	1	0	1	4	13	5	0	4	12	11	48
Total examinations .	50	63	82	129	185	221	250	297	927	892	1,154

TABLE V.

SHOWING NUMBER OF TIMES EACH TYPE WAS FOUND IN A NOSE, THE CORRESPONDING THROAT BEING ALSO INFECTED, BUT NOT WITH THE SAME TYPE. (See italics, Table III.)

	Ontario.	Newton, Mass.	Willard State Hospital, N.Y.	Brookline, Mass.	Springfield, Mass.	Washington, D.C.	Lowell, Mass.	Waltham, Mass.	Providence, R.I.	Boston, Mass.	Minnesota.
A	0	None of the types reported.	0	1	0	0	0	Types not minutely recorded.	0	0	9
A^1	0		0	0	0	0	0		0	0	2
A^2	0		0	0	0	0	0		0	0	0
B	0		0	0	0	0	0		0	1	2
B^1	0		0	0	0	0	0		0	0	6
B^2	0		0	0	0	0	0		0	0	0
C	0		0	0	0	0	0		0	0	25
C^1	0		0	0	0	0	0		3	0	28
C^2	0		0	1	0	0	0		1	0	16
D	0		0	0	0	0	0		0	1	26
D^1	0		0	0	0	0	0		2	12	73
D^2	1		0	1	2	0	0		13	12	135
E	0		0	0	0	0	0		0	1	9
E^1	0		0	0	0	0	0		0	0	11
E^2	1		0	0	1	3	0		0	3	131
F	0		0	0	0	0	0		0	0	0
F^2	0		0	0	0	0	0		0	0	3
G	0		0	0	0	0	0		0	0	2
G^2	0		0	0	0	0	0		0	4	22
Total noses infected when throats had other types	1	0	0	3	2	3	0	0	12	22	150
Totals	50	63	82	129	185	221	250	297	927	892	1,154

TABLE VI.

SHOWING NUMBER OF TIMES EACH TYPE WAS FOUND IN A THROAT, THE CORRESPONDING NOSE BEING ALSO INFECTED, BUT NOT WITH THE SAME TYPE. (See italics, Table III.)

	Ontario.	Newton, Mass.	Willard State Hospital, N.Y.	Brookline, Mass.	Springfield, Mass.	Washington, D.C.	Lowell, Mass.	Waltham, Mass.	Providence, R.I.	Boston, Mass.	Minnesota.
A	0	None of the types reported.	0	1	0	0	0	Types not minutely recorded.	0	2	11
A^1	0		0	0	0	0	0		0	0	4
A^2	0		0	0	0	0	0		0	0	1
B	0		0	0	0	0	0		0	0	1
B^1	0		0	0	0	0	0		0	0	11
B^2	0		0	0	0	0	0		0	0	0
C	0		0	0	0	1	0		0	2	17
C^1	0		0	0	0	0	0		3	0	6
C^2	0		0	2	0	0	0		9	0	7
D	0		0	1	0	0	0		0	2	11
D^1	0		0	0	1	0	0		1	1	56
D^2	0		0	1	2	0	0		4	15	99
E	0		0	1	0	0	0		0	1	4
E^1	0		0	0	0	1	0		0	0	7
E^2	1		0	0	1	0	0		0	0	83
F	0		0	0	0	1	0		0	0	2
F^2	0		0	0	0	0	0		0	0	4
G	0		0	0	0	0	0		0	0	3
G^2	0		0	0	0	1	0		0	2	9
Total throats infected when noses had other types	1	0	0	3	2	3	0	0	12	22	150
Total examined	50	63	82	129	185	221	250	297	927	892	1,154

TABLE VII.

SHOWING NUMBER OF TIMES EACH TYPE WAS FOUND IN BOTH THE NOSE AND THROAT OF THE SAME PERSON. (See italics, Table III.)

	Ontario.	Newton, Mass.	Willard State Hospital, N.Y.	Brookline, Mass.	Springfield, Mass.	Washington, D.C.	Lowell, Mass.	Waltham, Mass.	Providence, R.I.	Boston, Mass.	Minnesota.
A	0	None of the types reported.	0	0	0	0	0	Types not minutely recorded.	0	0	2
A^1	0		0	0	0	0	0		0	0	0
A^2	0		0	0	0	0	0		0	0	0
B	0		0	0	0	0	0		0	0	0
B^1	0		0	0	0	0	0		0	0	0
B^2	0		0	0	0	0	0		0	0	0
C	0		0	1	0	0	0		0	1	4
C^1	0		0	0	0	0	0		1	0	2
C^2	0		0	1	1	0	0		3	0	3
D	0		0	0	0	0	0		0	3	2
D^1	0		0	0	0	0	0		0	3	10
D^2	2		0	3	2	1	0		4	25	36
E	0		0	0	0	0	0		0	0	0
E^1	0		0	0	0	0	0		0	0	2
E^2	1		0	1	2	1	0		0	0	38
F	0		0	0	0	0	0		0	0	0
F^2	0		0	0	0	0	0		0	0	2
G	0		0	0	0	0	0		0	0	0
G^2	0		0	0	0	0	0		0	1	1
Total persons with both noses and throats infected with same type,	2	0	0	3	3	2	0	20	7	30	45
Total examined . .	50	63	82	129	185	221	250	297	927	892	1,154

TABLE VIII.

SHOWING NUMBER OF TIMES EACH TYPE WAS FOUND IN A PERSON, IN NOSE, THROAT, OR BOTH. (The sum of Tables III., IV., V., VI., VII.)

	Ontario.	Newton, Mass.	Willard State Hospital, N.Y.	Brookline, Mass.	Springfield, Mass.	Washington, D.C.	Lowell, Mass.	Waltham, Mass.	Providence, R.I.	Boston, Mass.	Minnesota.
A	0	None of the types reported.	0	3	0	0	0	Types not minutely recorded.	2	7	32
A^1	0		0	0	0	0	0		2	2	12
A^2	0		0	0	0	0	0		2	0	2
B	0		2	0	0	0	0		0	1	3
B^1	0		0	0	0	0	0		0	0	17
B^2	0		0	0	0	0	0		0	2	0
C	0		1	3	0	1	1		2	7	67
C^1	0		0	1	0	2	1		19	4	67
C^2	0		1	27	3	0	1		111	1	52
D	0		3	2	0	1	1		0	17	76
D^1	1		0	3	1	0	2		6	156	249
D^2	8		0	44	28	1	4		146	331	510
E	0		2	1	0	2	0		0	4	48
E^1	0		0	0	1	3	0		1	7	33
E^2	8		0	17	25	42	0		4	8	529
F	0		0	0	1	2	0		0	1	4
F^2	0		0	0	2	0	0		0	0	13
G	0		0	0	0	0	0		0	0	12
G^2	1		0	0	2	4	0		0	17	70
Total persons infected in either nose or throat or both with any of the types,	13	0	3	55	41	57	6	116	232	436	676
Total examined . .	50	63	82	129	185	221	250	297	927	892	1,154

TABLE IX.

SHOWING NUMBER OF TIMES EACH TYPE WAS FOUND IN A NOSE, WITHOUT REGARD TO THE FINDINGS IN THE CORRESPONDING THROAT. (The sum of Tables III., V., VII.)

	Ontario.	Newton, Mass.	Willard State Hospital, N.Y.	Brookline, Mass.	Springfield, Mass.	Washington, D.C.	Lowell, Mass.	Waltham, Mass.	Providence, R.I.	Boston, Mass.	TOTAL IN EAST.	Minnesota.	TOTAL IN BOTH.
A	0	None of the types reported.	0	1	0	0	0	Types not minutely recorded.	2	2	5	19	24
A^1	0		0	0	0	0	0		2	0	2	6	8
A^2	0		0	0	0	0	0		2	0	2	1	3
B	0		1	0	0	0	0		0	1	2	2	4
B^1	0		0	0	0	0	0		0	0	0	6	6
B^2	0		0	0	0	0	0		0	2	2	0	2
C	0		0	2	0	0	1		2	4	9	41	50
C^1	0		0	1	0	2	1		15	4	23	57	80
C^2	0		1	24	2	0	1		91	1	120	44	164
D	0		2	1	0	0	1		0	12	16	51	67
D^1	1		0	3	0	0	2		5	154	165	180	345
D^2	7		0	40	15	1	4		140	311	518	378	896
E	0		2	0	0	2	0		0	3	7	35	42
E^1	0		0	0	0	2	0		1	7	10	26	36
E^2	7		0	16	15	39	0		4	8	89	410	499
F	0		0	0	1	0	0		0	1	2	0	2
F^2	0		0	0	2	0	0		0	0	2	8	10
G	0		0	0	0	0	0		0	0	0	6	6
G^2	1		0	0	1	3	0		0	14	19	57	76
Total noses infected	11	0	2	48	26	49	6	112	208	403	865	478	1,343
Total noses examined	50	63	82	129	185	221	250	297	927	892	2,799*	1,154	3,953

*Omitting Waltham (297) because of incomplete classification of types.

TABLE X.

SHOWING NUMBER OF TIMES EACH TYPE WAS FOUND IN A THROAT, WITHOUT REGARD TO THE FINDINGS IN THE CORRESPONDING NOSE. (The sum of Tables IV., VI., VII., WITH THE ADDITION OF NEW YORK.)

	Ontario.	Newton, Mass.	Willard State Hospital, N.Y.	Brookline, Mass.	Springfield, Mass.	Washington, D.C.	Lowell, Mass.	Waltham, Mass.	Providence, R.I.	Boston, Mass.	New York, N.Y.	Total in East.	Minnesota.	Total in Both.
A	0	None of the types reported.	0	2	0	0	0	Types not minutely recorded.	0	5	3	10	15	25
A^1	0		0	0	0	0	0		0	2	1	3	6	9
A^2	0		0	0	0	0	0		0	0	3	3	1	4
B	0		1	0	0	0	0		0	0	3	4	1	5
B^1	0		0	0	0	0	0		0	0	0	0	11	11
B^2	0		0	0	0	0	0		0	0	3	3	0	3
C	0		1	2	0	1	0		0	4	12	20	30	50
C^1	0		0	0	0	0	0		5	0	3	8	12	20
C^2	0		0	4	2	0	0		23	0	14	43	11	54
D	0		1	1	0	1	0		0	8	9	20	27	47
D^1	0		0	0	1	0	0		1	5	3	10	79	89
D^2	3		0	7	15	1	0		10	45	7	88	168	256
E	0		0	1	0	0	0		0	1	2	4	13	17
E^1	0		0	0	1	1	0		0	0	0	2	9	11
E^2	2		0	2	12	4	0		0	0	27	47	157	204
F	0		0	0	0	2	0		0	0	3	5	4	9
F^2	0		0	0	0	0	0		0	0	1	1	7	8
G	0		0	0	0	0	0		0	0	0	0	6	6
G^2	0		0	0	1	1	0		0	4	0	6	14	20
Total throats infected	4	0	1	10	18	10	0	24	31	63	20	161	243	404
Total throats examined	50	63	82	129	185	221	250	297	927	892	200	2,999*	1,154	4,153

*Omitting Waltham (297) because of incomplete classification of types.

TABLE XI.

SHOWING NUMBER OF TIMES ANY REPRESENTATIVE OF THE GROUPS OF TYPES GIVEN WAS FOUND: (1) IN THE NOSE, (2) IN THE THROAT. *Since two or more representatives of the same group sometimes occurred in one nose (or throat), the total of times representatives of a group was found is in excess of the total noses (or throats) infected.* (This Table is based on Tables IX. and X., omitting New York and Waltham.)

GROUPS OF TYPES.	TIMES FOUND IN NOSE.						TIMES FOUND IN THROAT.					
	Total in East.	% in East.	Total in Minnesota.	% in Minnesota.	Total in Both.	% in Both.	Total in East.	% in East.	Total in Minnesota.	% in Minnesota.	Total in Both.	% in Both.
Total examined .	2,799		1,154		3,953		2,799		1,154		3,953	
A, C, D	30	1.07	111	9.65	141	3.58	26	0.91	72	6.26	98	2.48
Other granular . .	11	0.39	43	3.73	54	1.36	5	0.18	24	2.08	29	0.73
Barred	200	7.14	275	23.91	475	12.02	16	0.57	117	10.17	133	3.36
Solid	752	26.85	898	78.08	1,650	41.77	136	4.85	358	31.13	494	12.50

TABLE XII.

SHOWING THE RESULTS OF THE TESTS FOR VIRULENCE.

	Persons Not Exposed.						More or Less Exposed.				Definitely Exposed.		
	Results Positive.						Results Positive.				Results Positive.		
	Brookline, Mass.	Boston, Mass.	Lowell, Mass.	Providence, R.I.	Waltham, Mass.	Total.	Brookline, Mass.	New York, N.Y.	Willard State Hospital, N.Y.	Total.	Brookline, Mass.	Total.	Grand Total.
Granular	2	0	0	0	0	2	0	3	0	3	3	3	8
Barred	0	0	0	0	0	0	0	0	0	0	0	0	0
Solid	0	0	0	3	0	3	0	0	0	0	0	0	3
						5				3		3	11
	Results Negative.						Results Negative.				Results Negative.		
Granular	8	12	0	0	2	22	5	10	2	17	0	0	39
Barred	1	0	0	0	0	1	0	0	0	0	0	0	1
Solid	13	2	1	9	2	27	0	8	0	8	0	0	35
						50				25		0	75

TABLE XIII.—1. Showing Distribution of A in Well Persons.

	Ontario.	Newton, Mass.	Willard State Hospital, N.Y.	Brookline, Mass.	Springfield, Mass.	Washington, D.C.	Lowell, Mass.	Waltham, Mass.	Providence, R.I.	Boston, Mass.	Total in East.	Minnesota.	Grand Total.
Present in nose (throat free of all types)	0	0	0	0	0	0	0	0	2	2	4	8	12
Present in throat (nose free of all types)	0	0	0	1	0	0	0	0	0	3	4	2	6
Present in both nose and throat . . .	0	0	0	0	0	0	0	0	0	0	0	2	2
Present in nose (with other types in throat)	0	0	0	1	0	0	0	0	0	0	1	9	10
Present in throat (with other types in nose)	0	0	0	1	0	0	0	0	0	2	3	11	14
Total number of times A was found present	0	0	0	3	0	0	0	0	2	7	12	32	44
Total number of individuals examined .	50	63	82	129	185	221	250	297	927	892	3,096	1,154	4,250
Percentage of occurrence in clinical cases (throat only examined)	In 608 clinical cases Minnesota, State Board of Health Biennial Report, 1899–1900, p. 645.												36%

TABLE XIII. 2. Showing Distribution of A^1 in Well Persons.

Present in nose (throat free of all types)	0	0*	0	0	0	0	0	0	2	0	2	4	6
Present in throat (nose free of all types)	0	0	0	0	0	0	0	0	0	2	2	2	4
Present in both nose and throat . . .	0	0	0	0	0	0	0	0	0	0	0	0	0
Present in nose (with other types in throat)	0	0	0	0	0	0	0	0	0	0	0	2	2
Present in throat (with other types in nose)	0	0	0	0	0	0	0	0	0	0	0	4	4
Total number of times A^1 was found present	0	0	0	0	0	0	0	0	2	2	4	12	16
Total number of individuals examined .	50	63	82	129	185	221	250	297	927	892	3,096	1,154	4,250
Percentage of occurrence in clinical cases (throat only examined)	In 608 clinical cases in Minnesota.												1%

TABLE XIII.—3. Showing Distribution of A^2 in Well Persons.

Present in nose (throat free of all types)	0	0	0	0	0	0	0	0	2	0	2	1	3
Present in throat (nose free of all types)	0	0	0	0	0	0	0	0	0	0	0	0	0
Present in both nose and throat	0	0	0	0	0	0	0	0	0	0	0	0	0
Present in nose (with other types in throat)	0	0	0	0	0	0	0	0	0	0	0	0	0
Present in throat (with other types in nose)	0	0	0	0	0	0	0	0	0	0	0	1	1
Total number of times A^2 was found present	0	0	0	0	0	0	0	0	2	0	2	2	4
Total number of individuals examined .	50	63	82	129	185	221	250	297	927	892	3,096	1,154	4,250
Percentage of occurrence in clinical cases (throat only examined)	In 608 clinical cases in Minnesota.												18%

PLATE I.

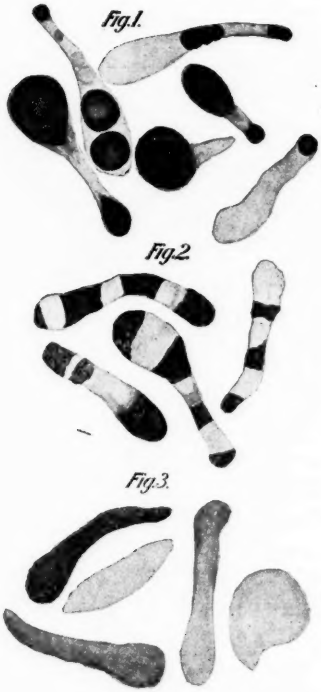


FIG. 1. Type A. 1 to 2 μ thick, 3 to 6 μ long.
FIG. 2. Type A^1. 1 to 2 μ thick, 3 to 6 μ long.
FIG. 3. Type A^2. 1 to 2 μ thick, 3 to 6 μ long.

The granules in A (Fig. 1) are reddish.

(This and the following plates represent, in black and white, *B. diphtheriæ* from serum cultures twelve to twenty-four hours old, stained with Loeffler's methylene blue. The reddish tint of the granules in types A, C, D, E, F, and G, noted under their respective figures, is an example of the metachromatism, well known as occurring in *B. diphtheriæ*, and certain other bacterial species. The plates are here reproduced, with the courteous permission of Dr. Wesbrook, from his original colored drawings. Colored reproductions are given in the Trans. Amer. Phys. 1900 and the Report of the Minnesota State Board of Health, 1899-1900.)

TABLE XIII.—4. SHOWING DISTRIBUTION OF B IN WELL PERSONS.

	Ontario.	Newton, Mass.	Willard State Hospital, N.Y.	Brookline, Mass.	Springfield, Mass.	Washington, D.C.	Lowell, Mass.	Waltham, Mass.	Providence, R.I.	Boston, Mass.	TOTAL IN EAST.	Minnesota.	GRAND TOTAL.
Present in nose (throat free of all types) .	0	0	1	0	0	0	0	0	0	0	1	0	1
Present in throat (nose free of all types)	0	0	1	0	0	0	0	0	0	0	1	0	1
Present in both nose and throat	0	0	0	0	0	0	0	0	0	0	0	0	0
Present in nose (with other types in throat)	0	0	0	0	0	0	0	0	0	1	1	2	3
Present in throat (with other types in nose)	0	0	0	0	0	0	0	0	0	0	0	1	1
Total number of times B was found present	0	0	2	0	0	0	0	0	0	1	3	3	6
Total number of individuals examined .	50	63	82	129	185	221	250	297	927	892	3,096	1,154	4,250
Percentage of occurrence in clinical cases (throat only examined)	In 608 clinical cases in Minnesota.												3%

TABLE XIII.—5. SHOWING DISTRIBUTION OF B^1 IN WELL PERSONS.

Present in nose (throat free of all types) .	0	0	0	0	0	0	0	0	0	0	0	0	0
Present in throat (nose free of all types) .	0	0	0	0	0	0	0	0	0	0	0	0	0
Present in both nose and throat	0	0	0	0	0	0	0	0	0	0	0	0	0
Present in nose (with other types in throat)	0	0	0	0	0	0	0	0	0	0	0	6	6
Present in throat (with other types in nose)	0	0	0	0	0	0	0	0	0	0	0	11	11
Total number of times B^1 was found present	0	0	0	0	0	0	0	0	0	0	0	17	17
Total number of individuals examined .	50	63	82	129	185	221	250	297	927	892	3,096	1,154	4,250
Percentage of occurrence in clinical cases (throat only examined)	In 608 clinical cases in Minnesota.												1%

TABLE XIII.—6. SHOWING DISTRIBUTION OF B^2 IN WELL PERSONS.

Present in nose (throat free of all types)	0	0	0	0	0	0	0	0	0	2	2	0	2
Present in throat (nose free of all types)	0	0	0	0	0	0	0	0	0	0	0	0	0
Present in both nose and throat	0	0	0	0	0	0	0	0	0	0	0	0	0
Present in nose (with other types in throat)	0	0	0	0	0	0	0	0	0	0	0	0	0
Present in throat (with other types in nose)	0	0	0	0	0	0	0	0	0	0	0	0	0
Total number of times B^2 was found present	0	0	0	0	0	0	0	0	0	2	2	0	2
Total number of individuals examined .	50	63	82	129	185	221	250	297	927	892	3,096	1,154	4,250
Percentage of occurrence in clinical cases (throat only examined)	In 608 clinical cases in Minnesota.												3%

PLATE II.

FIG. 1. Type B. 0.5 μ thick, 3 to 7 μ long.
FIG. 2. Type B^1. 0.5 μ thick, 3 to 7 μ long.
FIG. 3. Type B^2. 0.5 μ thick, 3 to 7 μ long.

The granules in B (Fig. 1) are dark blue.

TABLE XIII.—7. Showing Distribution of C in Well Persons.

	Ontario.	Newton, Mass.	Willard State Hospital, N.Y.	Brookline, Mass.	Springfield, Mass.	Washington, D.C.	Lowell, Mass.	Waltham, Mass.	Providence, R.I.	Boston, Mass.	Total in East.	Minnesota.	Grand Total.
Present in nose (throat free of all types) .	0	0	0	1	0	0	1	0	2	3	7	12	19
Present in throat (noses free of all types)	0	0	1	1	0	0	0	0	0	1	3	9	12
Present in both nose and throat . . .	0	0	0	1	0	0	0	0	0	1	2	4	6
Present in nose (with other types in throat)	0	0	0	0	0	0	0	0	0	0	0	25	25
Present in throat (with other types in nose)	0	0	0	0	0	1	0	0	0	2	3	17	20
Total number of times C was found present	0	0	1	3	0	1	1	0	2	7	5	67	82
Total number of individuals examined .	50	63	82	129	185	221	250	297	927	892	3,096	1,154	4,250
Percentage of occurrence in clinical cases (throat only examined)	In 608 clinical cases in Minnesota.												66%

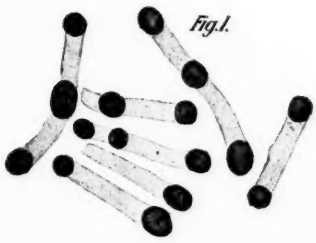
TABLE XIII.—8. Showing Distribution of C^1 in Well Persons.

Present in nose (throat free of all types)	0	0	0	1	0	2	1	0	11	4	19	27	46
Present in throat (nose free of all types)	0	0	0	0	0	0	0	0	1	0	1	4	5
Present in both nose and throat	0	0	0	0	0	0	0	0	1	0	1	2	3
Present in nose (with other types in throat	0	0	0	0	0	0	0	0	3	0	3	28	31
Present in throat (with other types in nose)	0	0	0	0	0	0	0	0	3	0	3	6	9
Total number of times C^1 was found present	0	0	0	1	0	2	1	0	19	4	27	67	94
Total number of individuals examined .	50	63	82	129	185	221	250	297	927	892	3,096	1,154	4,250
Percentage of occurrence in clinical cases (throat only examined)	In 608 clinical cases in Minnesota.												28%

TABLE XIII.—9. Showing Distribution of C^2 in Well Persons.

Present in nose (throat free of all types)	0	0	1	22	1	0	1	0	87	1	113	25	138
Present in throat (nose free of all types)	0	0	0	1	1	0	0	0	11	0	13	1	14
Present in both nose and throat	0	0	0	1	1	0	0	0	3	0	5	3	8
Present in nose (with other types in throat)	0	0	0	1	0	0	0	0	1	0	2	16	18
Present in throat (with other types in nose)	0	0	0	2	0	0	0	0	9	0	11	7	18
Total number of times C^2 was found present	0	0	1	27	3	0	1	0	111	1	144	52	196
Total number of individuals examined .	50	63	82	129	185	221	250	297	927	892	3,096	1,154	4,250
Percentage of occurrence in clinical cases (throat only examined)	In 608 clinical cases in Minnesota.												5%

PLATE III.



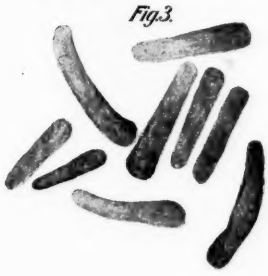


FIG. 1. Type C. 0.5 to 1 μ thick, 3 to 6 μ long.
FIG. 2. Type C^1. 0.5 to 1 μ thick, 3 to 6 μ long.
FIG. 3. Type C^2. 0.5 to 1 μ thick, 3 to 4 μ long.

The granules in C (Fig. 1) are reddish.

TABLE XIII.—10. Showing Distribution of D in Well Persons.

	Ontario.	Newton, Mass.	Willard State Hospital, N.Y.	Brookline, Mass.	Springfield, Mass.	Washington, D.C.	Lowell, Mass.	Waltham, Mass.	Providence, R.I.	Boston, Mass.	Total in East.	Minnesota.	Grand Total.
Present in nose (throat free of all types)	0	0	2	1	0	0	1	0	0	8	12	23	35
Present in throat (nose free of all types)	0	0	1	0	0	1	0	0	0	3	5	14	19
Present in both nose and throat	0	0	0	0	0	0	0	0	0	3	3	2	5
Present in nose (with other types in throat)	0	0	0	0	0	0	0	0	0	1	1	26	27
Present in throat (with other types in nose)	0	0	0	1	0	0	0	0	0	2	3	11	14
Total number of times D was found present	0	0	3	2	0	1	1	0	0	17	24	76	100
Total number of individuals examined .	50	63	82	129	185	221	250	297	927	892	3,096	1,154	4,250
Percentage of occurrence in clinical cases (throat only examined)	In 608 clinical cases in Minnesota.												83%

TABLE XIII.—11. Showing Distribution of D^1 in Well Persons.

Present in nose (throat free of all types)	1	0	0	3	0	0	2	0	3	139	148	97	245
Present in throat (nose free of all types)	0	0	0	0	0	0	0	0	0	1	1	13	14
Present in both nose and throat	0	0	0	0	0	0	0	0	0	3	3	10	13
Present in nose (with other types in throat)	0	0	0	0	0	0	0	0	2	12	14	73	87
Present in throat (with other types in nose)	0	0	0	0	1	0	0	0	1	1	3	56	59
Total number of times D^1 was found present	1	0	0	3	1	0	2	0	6	156	169	249	418
Total number of individuals examined .	50	63	82	129	185	221	250	297	927	892	3,096	1,154	4,250
Percentage of occurrence in clinical cases (throat only examined)	In 608 clinical cases in Minnesota.												32%

TABLE XIII.—12. Showing Distribution of D^2 in Well Persons.

Present in nose (throat free of all types) .	4	0	0	36	11	0	4	0	123	274	452	207	659
Present in throat (nose free of all types)	1	0	0	3	11	0	0	0	2	5	22	33	55
Present in both nose and throat	2	0	0	3	2	1	0	0	4	25	37	36	73
Ptesent in nose (with other types in throat)	1	0	0	1	2	0	0	0	13	12	29	135	164
Present in throat (with other types in nose)	0	0	0	1	2	0	0	0	4	15	22	99	121
Total number of times D^2 was found present	8	0	0	44	28	1	4	0	146	331	562	510	1,072
Total number of individuals examined .	50	63	82	129	185	221	250	297	927	892	3,096	1,154	4,250
Percentage of occurrence in clinical cases (throat only examined)	In 608 clinical cases in Minnesota.												55%

PLATE IV.

FIG. 1. Type D. 0.75 to 1 μ thick, 2 to 3 μ long.
FIG. 2. Type D^1. 0.5 to 1 μ thick, 2 to 3 μ long.
FIG. 3. Type D^2. 0.75 to 1 μ thick, 1 to 2.5 μ long.

The granules in D (Fig. 1) are reddish.

TABLE XIII.—13. SHOWING DISTRIBUTION OF E IN WELL PERSONS.

	Ontario.	Newton, Mass.	Willard State Hospital, N.Y.	Brookline, Mass.	Springfield, Mass.	Washington, D.C.	Lowell, Mass.	Waltham, Mass.	Providence, R.I.	Boston, Mass.	TOTAL IN EAST.	Minnesota.	GRAND TOTAL.
Present in nose throat free of all types) .	0	0	2	0	0	2	0	0	0	2	6	26	32
Present in throat (nose free of all types)	0	0	0	0	0	0	0	0	0	0	0	9	9
Present in both nose and throat	0	0	0	0	0	0	0	0	0	0	0	0	0
Present in nose (with other types in throat)	0	0	0	0	0	0	0	0	0	1	1	9	10
Present in throat (with other types in nose)	0	0	0	1	0	0	0	0	0	1	2	4	6
Total number of times E was found present	0	0	2	1	0	2	0	0	0	4	9	48	57
Total number of individuals examined .	50	63	82	129	185	221	250	297	927	892	3,096	1,154	4,250
Percentage of occurrence in clinical cases (throat only examined)	In 608 clinical cases in Minnesota.												49%

TABLE XIII.—14. SHOWING DISTRIBUTION OF E^1 IN WELL PERSONS.

Present in nose (throat free of all types)	0	0	0	0	0	2	0	0	1	7	10	13	23
Present in throat (nose free of all types)	0	0	0	0	1	0	0	0	0	0	1	0	1
Present in both nose and throat	0	0	0	0	0	0	0	0	0	0	0	2	2
Present in nose (with other types in throat)	0	0	0	0	0	0	0	0	0	0	0	11	11
Present in throat (with other types in nose)	0	0	0	0	0	1	0	0	0	0	1	7	8
Total number of times E^1 was found present	0	0	0	0	1	3	0	0	1	7	12	33	45
Total number of individuals examined .	50	63	82	129	185	221	250	297	927	892	3,096	1,154	4,250
Percentage of occurrence in clinical cases (throat only examined)	In 608 clinical cases in Minnesota.												44%

TABLE XIII.—15. SHOWING DISTRIBUTION OF E^2 IN WELL PERSONS.

Present in nose (throat free of all types) .	5	0	0	15	12	35	0	0	4	5	76	241	317
Present in throat (nose free of all types) .	0	0	0	1	9	3	0	0	0	0	13	36	49
Present in both nose and throat	1	0	0	1	2	1	0	0	0	0	5	38	43
Present in nose (with other types in throat)	1	0	0	0	1	3	0	0	0	3	8	131	139
Present in throat (with other types in nose)	1	0	0	0	1	0	0	0	0	0	2	83	85
Total number of times E^2 was found present	8	0	0	17	25	42	0	0	4	8	104	529	633
Total number of individuals examined .	50	63	82	129	185	221	250	297	927	892	3,096	1,154	4,250
Percentage of occurrence in clinical cases (throat only examined)	In 608 clinical cases in Minnesota.												30%

PLATE V.

Fig.1.

Fig.2.

Fig.3.

FIG. 1. Type E. 0.5 to 0.75 μ thick, 1.5 μ long.
FIG. 2. Type E^1. 0.5 to 0.75 μ thick, 1.5 to 2 μ long.
FIG. 3. Type E^2. 0.5 to 0.75 μ thick, 1 to 2 μ long.

The granules in E (Fig. 1) are reddish.

TABLE XIII.—16. Showing Distribution of F in Well Persons.

	Ontario.	Newton, Mass.	Willard State Hospital, N.Y.	Brookline, Mass.	Springfield, Mass.	Washington, D.C.	Lowell, Mass.	Waltham, Mass.	Providence, R.I.	Boston, Mass.	Total in East.	Minnesota.	Grand Total.
Present in nose (throat free of all types) .	0	0	0	0	1	0	0	0	0	1	2	0	2
Present in throat (nose free of all types) .	0	0	0	0	0	1	0	0	0	0	1	2	3
Present in both nose and throat	0	0	0	0	0	0	0	0	0	0	0	0	0
Present in nose (with other types in throat)	0	0	0	0	0	0	0	0	0	0	0	0	0
Present in throat (with other types in nose)	0	0	0	0	0	1	0	0	0	0	1	2	3
Total number of times F was found present	0	0	0	0	1	2	0	0	0	1	4	4	8
Total number of individuals examined .	50	63	82	129	185	221	250	297	927	892	3,096	1,154	4,250
Percentage of occurrence in clinical cases (throat only examined)	In 608 clinical cases in Minnesota.												2%

TABLE XIII.—17. Showing Distribution of F^2 in Well Persons.

Present in nose (throat free of all types) .	0	0	0	0	2	0	0	0	0	0	2	3	5
Present in throat (nose free of all types) .	0	0	0	0	0	0	0	0	0	0	0	1	1
Present in both nose and throat . . .	0	0	0	0	0	0	0	0	0	0	0	2	2
Present in nose (with other types in throat)	0	0	0	0	0	0	0	0	0	0	0	3	3
Present in throat (with other types in nose)	0	0	0	0	0	0	0	0	0	0	0	4	4
Total number of times F^2 was found present	0	0	0	0	2	0	0	0	0	0	2	13	15
Total number of individuals examined .	50	63	82	129	185	221	250	297	927	892	3,096	1,154	4,250
Percentage of occurrence in clinical cases (throat only examined)	In 608 clinical cases in Minnesota.												3%

TABLE XIII.—18. Showing Distribution of G in Well Persons.

Present in nose (throat free of all types) .	0	0	0	0	0	0	0	0	0	0	0	4	4
Present in throat (nose free of all types)	0	0	0	0	0	0	0	0	0	0	0	3	3
Present in both nose and throat	0	0	0	0	0	0	0	0	0	0	0	0	0
Present in nose (with other types in throat)	0	0	0	0	0	0	0	0	0	0	0	2	2
Present in throat (with other types in nose)	0	0	0	0	0	0	0	0	0	0	0	3	3
Total number of times G was found present	0	0	0	0	0	0	0	0	0	0	0	12	12
Total number of individuals examined .	50	63	82	129	185	221	250	297	927	892	3,096	1,154	4,250
Percentage of occurrence in clinical cases (throat only examined)	In 608 clinical cases in Minnesota.												4%

TABLE XIII.—19. Showing Distribution of G^2 in Well Persons.

Present in nose (throat free of all types) .	1	0	0	0	1	3	0	0	0	9	14	34	48
Present in throat (nose free of all types) .	0	0	0	0	1	0	0	0	0	1	2	4	6
Present in both nose and throat	0	0	0	0	0	0	0	0	0	1	1	1	2
Present in nose (with other types in throat)	0	0	0	0	0	0	0	0	0	4	4	22	26
Present in throat (with other types in nose)	0	0	0	0	0	1	0	0	0	2	3	9	12
Total number of times G^2 was found present	1	0	0	0	2	4	0	0	0	17	24	70	94
Total number of individuals examined .	50	63	82	129	185	221	250	297	927	892	3,096	1,154	4,250
Percentage of occurrence in clinical cases (throat only examined)	In 608 clinical cases in Minnesota.												4%

PLATE VI.

FIG. 1. Type F. 0.25 to 0.5 μ thick, 1 to 2 μ long.
FIG. 2. Type F². 0.25 μ thick, 1 to 2 μ long.
FIG. 3. Type G. 0.5 to 0.75 μ thick, 1 to 1.5 μ long.
FIG. 4. Type G². 0.5 to 0.75 μ thick, 1 to 1.25 μ long.

The granules in F (Fig. 1) and G (Fig. 3) are reddish.

The CHAIRMAN.— I am sorry to say we have but a few minutes more in which we can use the hall; but such a report as this should not fall without discussion, and the question is now open for discussion.

Dr. HILL.— Mr. Chairman and gentlemen, as the secretary of this committee, I owe you an apology for addressing you in the discussion; but there were certain points brought out by this report which it might be well to review.

The percentage of diphtheria bacilli found in well persons in Providence ran, according to the report, about 9 per cent. Professor Gorham, however, tells me that probably 25 per cent. more accurately represents the facts, if all types are considered. On the other hand, by confining ourselves to the specific types, A, C and D, Providence would run less than Boston, or about one-half of 1 per cent.

This report confirms in every way the theoretical considerations which have hitherto been entertained with regard to the isolation of patients, merely showing that some of those theoretical considerations cannot always be carried out in practice, at least at the present time. The careful consideration which, as secretary of the committee, I have been able to give the report for some time past, convinces me that no change of moment in Boston methods as conducted at present need result from adhering to the committee's recommendations. I think that perhaps this statement may be of some little interest to you, because various men have come to me, and said: "Boston is the largest place in the State, and the centre of the diphtheria of the State. [72 per cent. of the diphtheria of the State in 1900 occurred within ten miles of Boston.] We would like to know how this report is going to affect you." I have been able to tell them, conscientiously, that it need make no change in our methods. Although it is a report which upsets some previous ideas, and very rightly so, it does not necessarily affect us in practice here. What it may do for places where other procedures have been followed, I cannot say.

The CHAIRMAN.— It has been suggested that the discussion of this subject is of too great importance to be absolutely cut off, and

that at the next meeting it might be resumed; and I think this is a good suggestion. It is unfortunate that everything should be so good as to take the whole afternoon and to bring us down to five o'clock, when we must vacate the room, without having fully completed a discussion of these excellent papers. I want to say, before the adjournment, that, if any member should feel that it is strange that all the meetings are held in Boston, such member is reminded that it is solely because no invitations are given for the meetings to be held elsewhere; and it is better that we should hold them in Boston, perhaps, than not hold them at all. By the by-laws we must hold two of them in Boston; but the other two, the April and October meetings, should really be held in other parts of the State or in Providence, and I think most of the Association would be very glad to visit these places. Among my notes of things to mention this afternoon is one upon the selection of papers. One of the hardest things to do is to find living subjects, those which will entertain and interest the members most. It is not always easy for anybody to do. I assure you the committee would be greatly pleased if you were to suggest topics for discussion, subjects for papers, and those which you care most for, those which shall interest the larger part of the Association. I had not finished these notes when a member, much to my delight, came forward, and made a suggestion upon one of these topics, and that suggestion was this: that at some meeting the whole afternoon be devoted to questions from members of the Association concerning topics that they would like to hear discussed, questions which they would like to hear answered by those having had experience. It is an excellent suggestion, and it pleased me very much. I hope it will you. This gentleman was from Salem, one of the oldest and best cities of Massachusetts: therefore, it must be good. I want to ask the Association now if they are ready for the question as to whether it would be their pleasure at the very next meeting to have the time devoted to questions from the members of the Association.

Mr. COFFEY.— Might I suggest that you have already appropriated some of the time of the next meeting to a discussion of these papers?

The CHAIRMAN.— Yes. While a portion of the meeting is already mortgaged, it still remains to be decided whether the Association will have the remainder of the meeting devoted to questions and answers,— questions proposed by the members of the Association. Those in favor will say aye.

The motion was adopted unanimously.

The CHAIRMAN.— It is a unanimous vote. The next meeting will be held, if you will permit us, at Gallup's Island; and you will be the guests, as usual, of the Boston Board of Health. Is there any other business to come before the meeting?

On motion of Dr. Chapin, of Providence, the Committee on Diphtheria Bacilli in Well Persons was continued, in order that it might take charge of the editing of the report for the *Journal*. The Association then adjourned.